# INFORMOSOME

## Volume III

**A Compendium cum E-Proceedings**

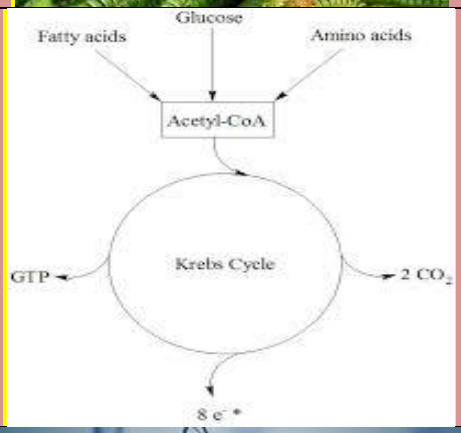
**of Departmental Seminars given**

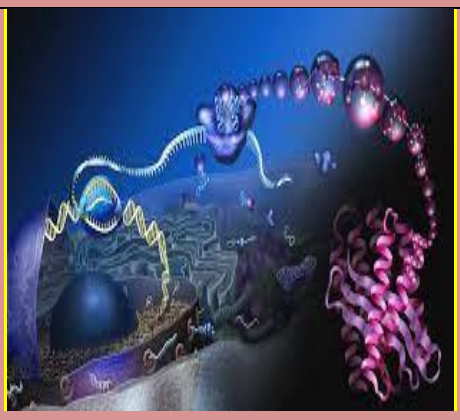
**By the students of UG, Botany Honours.**

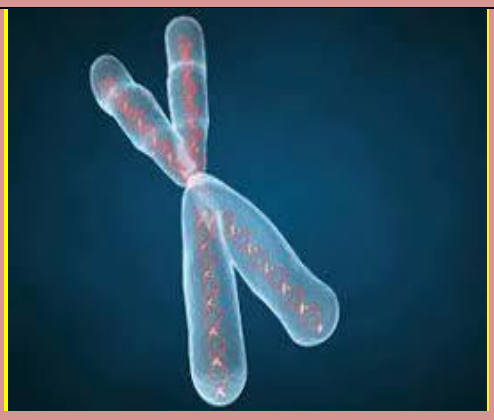
**An initiative of the Department of Botany (UG and PG)**

**Hooghly Mohsin college, Chinsurah, Hooghly, West Bengal, India**


CHARACTERISTICS
Study.com


Glucose
Fatty acids
Amino acids
Acetyl-CoA
Krebs Cycle
GTP
2 $CO_2$
8 $e^-$ *





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UGC recognized **"COLLEGE WITH POTENTIAL FOR EXCELENCE",** DST(Govt of India) Fund for improvement of S&T Infrastructure(**DST-FIST**), Department of biotechnology(Govt. of India) Awarded **"Star College"**

Date: 26/08/2021

From:

The Head (HOD)

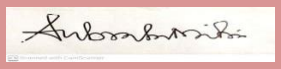
PG Department of Botany,

Hooghly Mohsin College, Chuchura, Hooghly.

It is really an event of exhilaration that Botany Department of Hooghly Mohsin College is going to release students seminar volume 'INFORMOSOME'.

Students' seminars provide an opportunity to give expression of their ideas and vision and display their creativity and imagination and develop them to their full potential. Young students are thus equipped enough to meet the challenges of life in a mature and effective way. I am sure that under the guidance of teachers and overall supervision; provide students a platform for maturing their literary talents.

I extend my best wishes to the students' community and hope that this seminar volume will be a shining record of the achievements of the students and teachers and inspire all to a greater heights.



Dr.SUBRATA MITRA, ASSOCIATE PROF. AND HEAD, UNDER GRADUATE AND POST GRADUATE DEPT. OF BOTANY,HOOGHLY MOHSIN COLLEGE. CHUCHURA, HOOGHLY

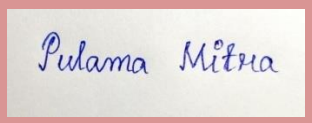
# Note from Assistant Editors desk: -

The topics covered in this eBook include various aspects in the field of Botany. The students have carried out the work on topics which include classical as well as applied portions of Botany. The classical portions of this field include topics such as the types of venation in leaf, structure of gynoecium in flowers, various fungi (such as *Ascobolus, Agaricus)* and many others. On the other hand topics covering the applied portions include structure of DNA, experiments proving DNA to be the genetic material, structure of nucleosome and chromatin, gene mutations etc. Topics on practical aspects of life such as the impact of Covid-19, defense system of the Sunderbans against natural calamities have also been covered in this eBook.

While going through their papers we realized that they have researched a lot on the particular topics and thus they have provided a lot of information. Many of the students have gone through the core portions of their respective topics in order to complete this research work. Several links and references of the respective texts as well as the pictures have been provided. These links provide a broad field of gaining knowledge in various aspects as they lead to a vast source of information. These links as well as the sub-links present in each site have also enriched our knowledge. Topics which are of main concern in today's life have been discussed in this eBook. Pictorial representations, diagrams, graphs have also been added for the better understanding of their particular topic. The methods of representation of all the individual students are quite elucidative. While reviewing their papers we also enhanced our knowledge and came across several new facts and discoveries that we were not aware of.

The students have done a great job on their part. From the very inception of their student hood in the department they have been working hard and they are emotionally quite attached with this project. I wish them every success in all their future endeavors.

(ARKA DEY, 3rd year, Assistant Editor)



(PULAMA MITRA, 3rd year, Assistant Editor)

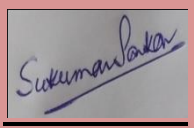
# A note from Associate Editors' Desk

It gives us an immense pleasure to announce that the department of Botany, Hooghly Mohsin College, boasts of a bunch of budding botanists who are really enthusiastic in showcasing their prowess and mettle in delivering and writing some very interesting research papers on the very onset of their inception in this department. The students are our pride and their honest endeavours has culminated in shaping this E-seminar Proceeding-cum-scientific dossier that highlights some varied and updated knowledge about the myriad aspects of Plant Science. All the departmental professors have given their valuable inputs into shaping up the inquisitive minds of our students, without whose help and active support the whole episode would have been a mess.

The students have tried to showcase their enthusiasm in selecting their topic, and reading and writing the manuscripts and delivering their seminar talks that entailed their genuine hard work. We have encouraged the First Year ($2^{nd}$ semester) UG students to concentrate on the core and fundamental topics of Botany and give their utmost sincerity to prove their foundation and knowledge. The $2^{nd}$ year ($4^{th}$ Semester) students have chosen a wide array of topics which included cell biology; Orchid biology and fundamental molecular biology, which they have conceptualized from their syllabus. But they have taken a wonderful venture to explore the insights of the topics chosen, and they were ultimately able to come up with wonderful papers. The final semester students (Semester VI) were extremely prudent in choosing the topics for paper writing. They exploration ranges from the world of plant genetics and breeding to Plant biotechnology to environmental Biotechnology. Their outreaches have really been well documented, thoroughly researched and scientifically represented.

We could see that our encouragement and support induced the scientific temperament of literature searching, data collection, documentation vis- a- vis content writing with scientific explanations and comments in our students against the backdrop of the toughest days of Covid pandemic. I feel our efforts that we are able to take the appropriate steps in this regard, which has been extremely successful.

We wish them all-round success in their future academic life.



Dr. Manashi Aditya, (Assistant Professor, Associate Editor, Informosome)

Dr. Sukumar Sarkar (Associate Professor, Associate Editor, Informosome)

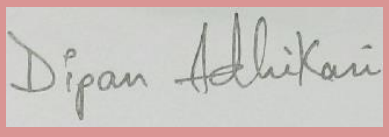
## From Editor-in-Chief's Desk:

Knowledge is power and information is the foundation of knowledge. In the toughest hours of Covid pandemic, when the normal life came to a standstill, the Department of Botany, Hooghly Mohsin College had been engaged in an episode of constant academic care and encouragement for all the students of this department to cater to them in the utmost way possible. In this event of online activities, the department had organized students' seminars and encouraged them to utilize the challenge of writing scientific paper. The department is indebted to Dr. Debobrata Mukhopadhyay (Ex-HOD) of the department in this context, who constantly encouraged and created an atmosphere of motivation among all the departmental staffs and the students to excel in a better way. This constant encouragement and interactions had yielded this result in the shape of this ebook cum seminar proceedings for the first time in the history of this department. All the departmental staff members were cordial and energetic to reap this fruit.

While editing the scientific writing of the students, what I could envisage that the students are highly motivated and technologically savvy in preparing their research articles. They have done sound research and literature reviewing to choose the topics, data collection and content development. What is also a point of great delight that all of them followed the finer nuances of scientific paper writing at this very tender age as undergraduate students. The choice of topic and content developments were delightful and engrossing to read. I have enjoyed a lot reading these write-ups.

We, the teachers of this department, are the stakeholders of the emotional content development of our students apart from helping them in their regular academic pursuits. I strongly feel all the departmental teachers are whole-heartedly devoted to quenching their thirst for knowledge and developing their scientific acumen. This has been nicely reflected in their deliverance of seminar lecture and paper writing.

I wish them all-round development of their scientific career in the coming years.



**(Dr. Dipan Adhikari, Assistant Professor and Editor-in-Chief, Informosome, the e-book)**

# Table of Contents

## Paper – I

# GENE MUTATION

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## ABSTRACT

Gene mutations are changes that take place to the sequence of nucleotides on the DNA molecule that is other than genetic recombination.Gene mutations can arise due to natural reasons, such as errors in the replication process, and these mutations are known as spontaneous mutations. Mutations also arise due to outside factors called mutagens and these are known as induced mutations.Mutations in human genes can be responsible for inherited genetic disorders and cancer. Mutations can arise due to environmental factors or spontaneously. It has been shown that certain DNA sequences are more prone to mutate. These sites are termed hotspots and exhibit a higher mutation frequency than expected by chance. In contrast, DNA sequences with lower mutation frequencies than expected by chance are termed coldspots. Mutation that occur in coding frame of DNA region which of their expression are responsible for synthesis of specific products could be rise of genetic disease, because the lost of gene function. Somatic cell mutation is able to create genetic variance in a cell population and can induce cancer and tumor when gene mutations took place at repressor gene in controlling cell cycles such as p53 gene. Whereas germ-line cell mutation can cause genetic disease such as sickle cell anaemia, breast cancer, thalassemia, 8ecognize's as well as defect of biochemical pathway that influence drug-receptor interaction, which has negative effect and lead to hospitalized of patient.

Mutations can be categorized into two groups – point mutations (also known as base pair mutations or base pair substitutions) and insertion/deletions. Both point mutations and insertion/deletions can also be nonsense mutations, in which a codon is switched to a stop codon. This terminates the polypeptide prematurely and causes it to become non-functional.

## INTRODUCTION

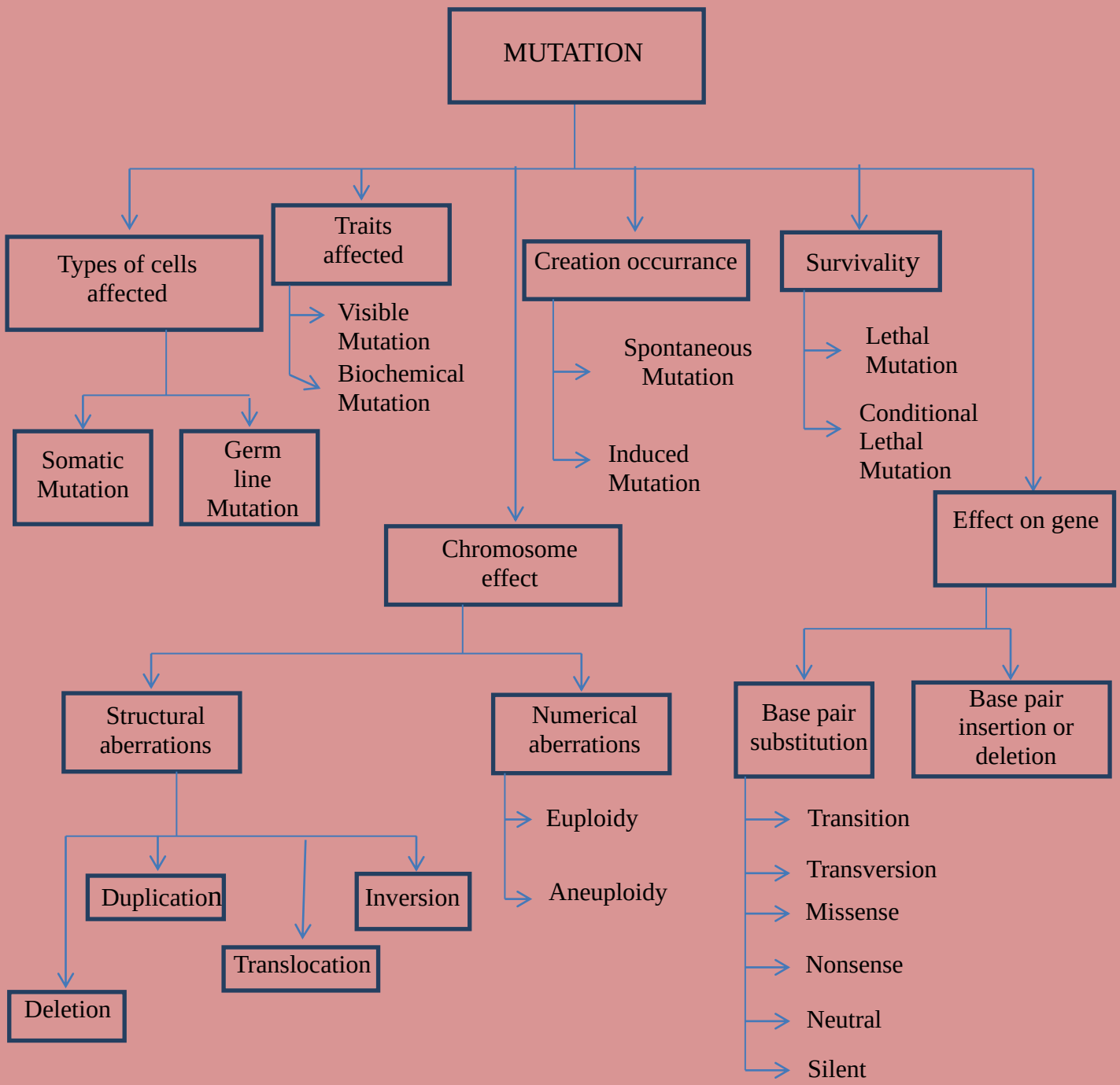
In biology, a mutation is an alteration in the nucleotide sequence of the genome of an organism, virus, or extra chromosomal DNA. Viral genomes contain either DNA or RNA. Mutations result from errors during DNA or viral replication, mitosis, or meiosis or other types of damage to DNA (such as pyrimidine dimers caused by exposure to ultraviolet radiation), which then may undergo error-prone repair (especially micro homology-mediated end joining), cause an error during other forms of repair, or cause an error during replication (translesion synthesis). Mutations may also result from an insertion or deletion of segments of DNA due to mobile genetic elements. Mutations may or may not produce detectable changes in the observable characteristics (phenotype) of an organism. Mutations play a part in both normal and abnormal biological processes including: evolution, cancer, and the development of the immune system, including junction diversity. Mutations can introduce new alleles into a population of organisms and increase the population's genetic variation, providing the raw material on which evolutionary forces such as natural selection can act. Mutation can result in many different types of change in sequences. Mutations in genes can have no effect, alter the product of a gene, or prevent the gene from functioning properly or completely. Mutations can also occur in nongenic regions.

A 2007 study on genetic variations between different species of *Drosophila* suggested that, if a mutation changes a protein produced by a gene, the result is likely to be harmful, with an estimated 70% of amino acid polymorphisms that have damaging effects, and the remainder being either neutral or marginally beneficial. Due to the damaging effects that mutations can have on genes, organisms have mechanisms such as DNA repair to prevent or correct mutations byreverting the mutated sequence back to its original state.

## OVERVIEW

- A mutation is an alteration in the nucleotide sequence of the genome of an organism, virus, or extrachromosomal DNA.
- Mutation can result in many different types of change in sequences. Mutations in genes can have no effect, alter the product of a gene, or prevent the gene from functioning properly or completely.
- Mutation is the ultimate source of all genetic variation, providing the raw material on which evolutionary forces such as natural selection can act.

## TYPES OF MUTATION



## ❖ BASE PAIR SUBSTITUTION / POINT MUTATION –

1. **Transition mutation** – Substitution of a purine or pyrimidine by a different purine or pyrimidine respectively, i.e. mutation from one purine-pyrimidine base-pair to the other purine-pyrimidine base-pair.

   E.g. – GC – AT , CG – TA

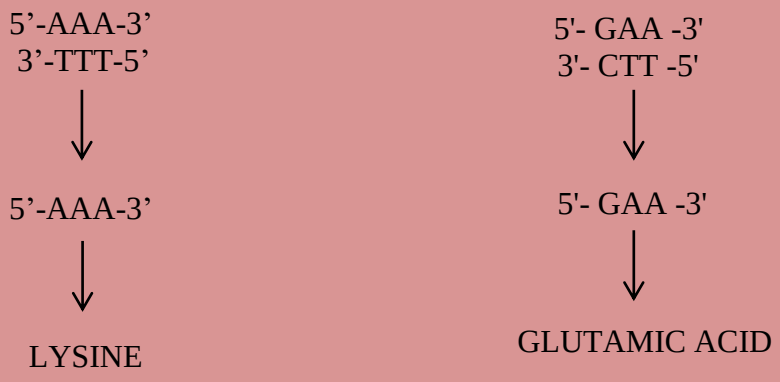
   **(Source – iGenetics A Molecular Approach, Peter J. Russell, Third edition, p-132)**

2. **Transversion mutation** – Substitution of purine by a pyrimidine, i.e. mutation from a purine-pyrimidine base-pair to a pyrimidine-purine base-pair.

   E.g. – AT – CG, GC – TA

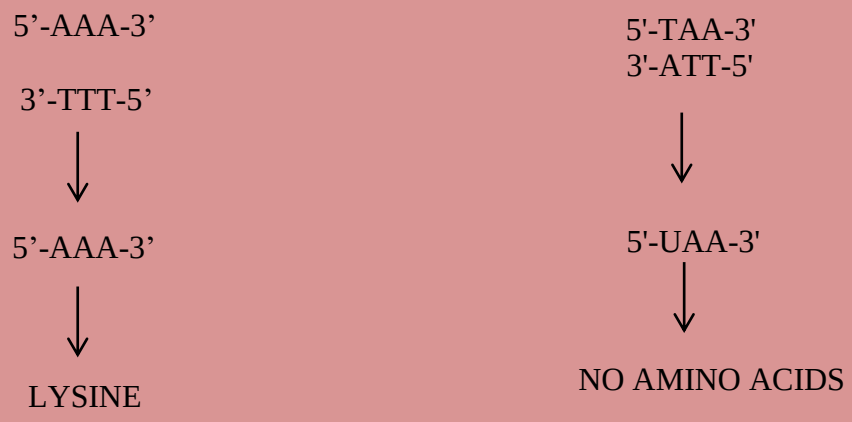
   **(Source – iGenetics A Molecular Approach, Peter J. Russell,)**

3. **Missense Mutation** – Substitution or deletion of one or two or more nucleotides in a triplet codon, i.e. a mutation where a base-pair change causes a change in an Mrna codon so that a different amino acid is inserted into the polypeptide.




**(Source - iGenetics A Molecular Approach, Peter J. Russell,)**

4. **Nonsense Mutation** – Change in a nucleotide alters a triplet into a stop codon, i.e. a gene mutation in which a base-pair change alters an Mrna codon for an amino acid to a stop (nonsense) codon.




**(Source – iGenetics A Molecular Approach, Peter J. Russell,)**

5. **Neutral Mutation** – Change in a nucleotide of a triplet but doesnot produce any detectable change in amino acid function, i.e. a base-pair change in a gene changes Mrna codon, but resulting amino acid substitution produces no detectable change in protein function.


**(Source - iGenetics A Molecular Approach, Peter J. Russell,)**

6. **Silent Mutation** – Change in the third or wobble base of a triplet so that no difference is noted during translation, i.e. mutation changes a base-pair but the altered Mrna codon specifies the same amino acid in the protein.


**(Source – iGenetics A Molecular Approach, Peter J. Russell,)**

## ❖ BASE PAIR INSERTION OR DELETION / FRAMESHIFT MUTATION

Addition or deletion of nucleotides in a stretch of DNA so that the reading frame becomes displaced or shifted, i.e. if one or more base-pairs are added to or deleted from a protein coding gene, the reading frame of an Mrna can change downstream of the mutation.


**(Source - iGenetics A Molecular Approach, Peter J. Russell,)**

## EFFECT ON PHENOTYPES:-

- ✓ Forward Mutation – Changes a wild type gene into a mutant gene.
- ✓ Backward Mutation – Changes a mutant gene into a wild type gene.

In another way inhibition of mutation also affect phenotype which is known as suppressor mutation. It is of two types:

- ✓ Intragenic – Suppressed by another mutation on the same gene.
- ✓ Intergenic / Extragenic – Suppressed by another mutation into another gene.

**(Source – iGenetics A Molecular Approach, Peter J. Russell,)**

## CAUSES OF MUTATION

1. **Spontaneous Mutation** – all types of point mutations occur spontaneously. Spontaneous mutations generally occur due to – DNA replication errors and spontaneous chemical changes.

2. **Induced Mutation** – are alterations in the gene after it has come in contact with mutagens. Induced mutations on the molecular level can be caused by: chemicals, hydroxylamine, base analogs. Mutagens are of two types –

a. **Physical Mutagens** – UV rays (Non-ionising radiation) , X- ray , gamma rays (Ionising radiation)

b. **Chemical Mutagens** – They are again of 3 basic types:-

Intercalating agents

Base analogs

Base modifying agents

- **Intercalating agents** – are hydrophobic heterocyclic ring molecules that resemble the ring structure of base pairs, such as the ethidium bromide, proflavin, acridine orange and actinomycin D. Insertion of these agents distorts the DNA double helix, thereby interfering with DNA replication, transcription, and repair.

**(Source – https://www.sciencedirect.com)**

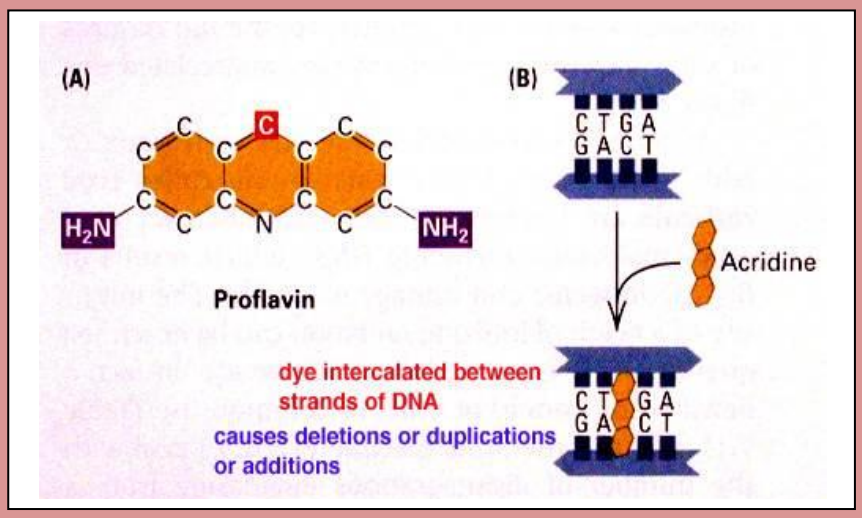



**Figure –** Function of intercalating agents

**Source - https://biotechkhan.files.wordpress.com**

- **Base analogs -** are molecules which have a very similar structure to one of the four nitrogenous bases which are used in DNA (adenine, guanine, cytosine or thymine). They form a structure similar to one of the DNA nucleotides and then can be used to form the new strand in semi conservative replication.

**(Source - https://teaching.ncl.ac.uk)**

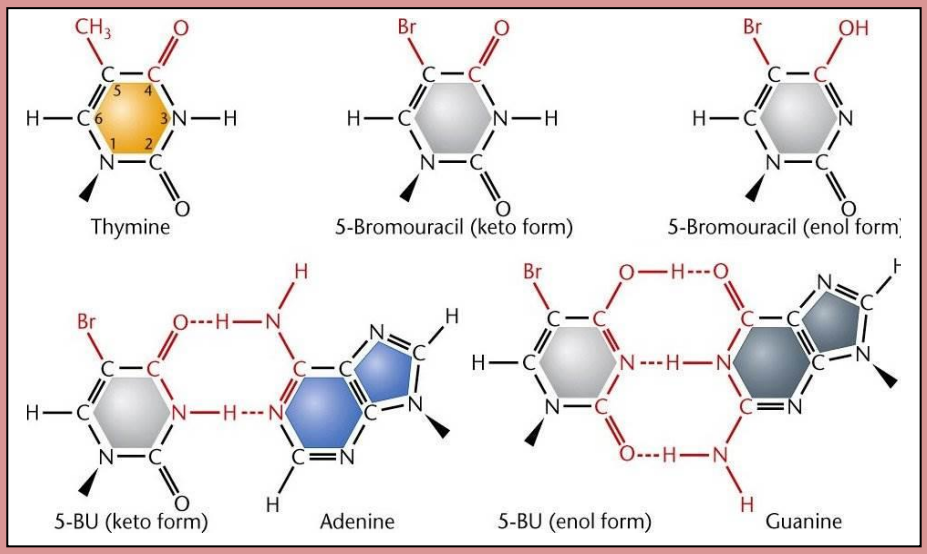



**Figure –** Mechanism of action of base analogs

**Source - https://biotechkhan.files.wordpress.com**

- **Base modifying agents** – are of three types

I. Deaminating agents – a chemical agent which exhibits the capability of causing the loss of an amine functional group on another molecular entity (e.g. DNA or protein) is referred to as a deaminating agent.

**(Source - https://www.ebi.ac.uk)**

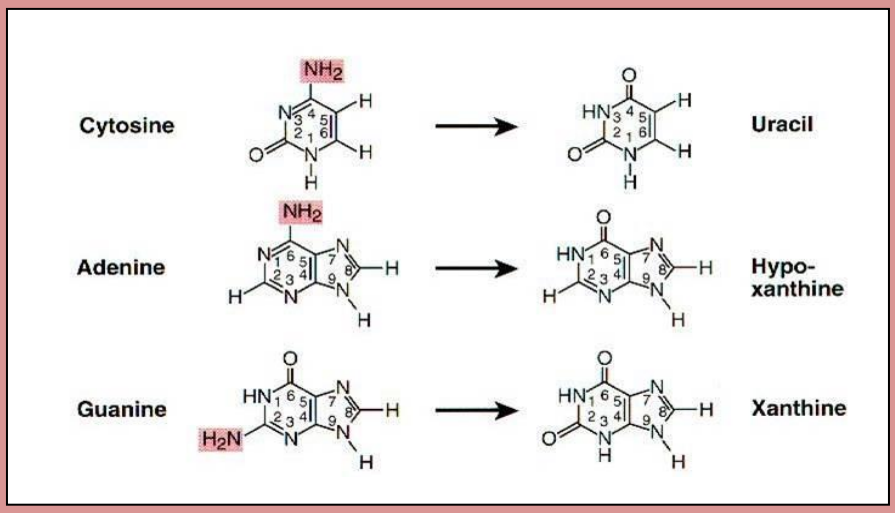



**Figure –** Function of deaminating agents

**Source - https://biotechkhan.files.wordpress.com**

II. Hydroxylating agents – Hydroxylamine is a mutagen that reacts specifically with cytosine ,modifying it by adding a hydroxyl group (OH) so that it pair with adenine instead of guanine.

**(Source - https://www.slideshare.net (Slide 18) )**

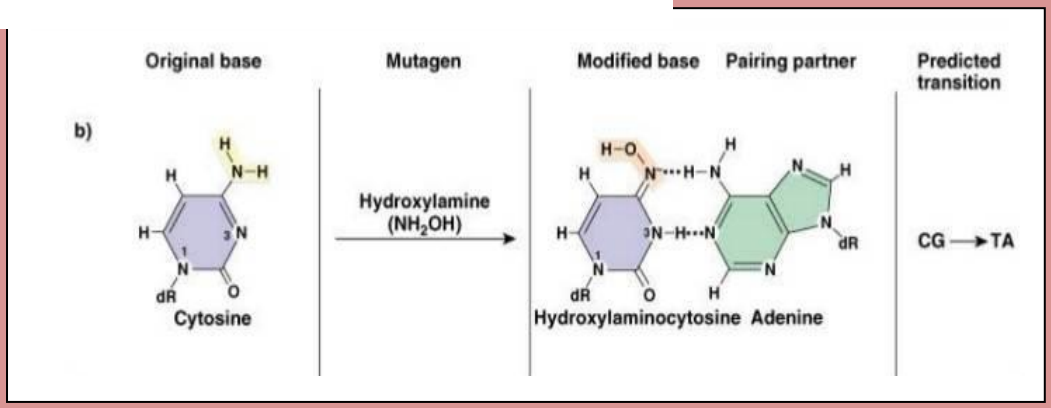


**Figure –** Mechanism of action of hydroxylating agents

**Source - http://www.surendranathcollege.org (Page - 2)**

III. Alkylating agents – Alkylating agents are compounds that work by adding an alkyl group to the guanine base of the DNA molecule, preventing the strands of the double helix from linking as they should.

**(Source -https://www.drugs.com)**

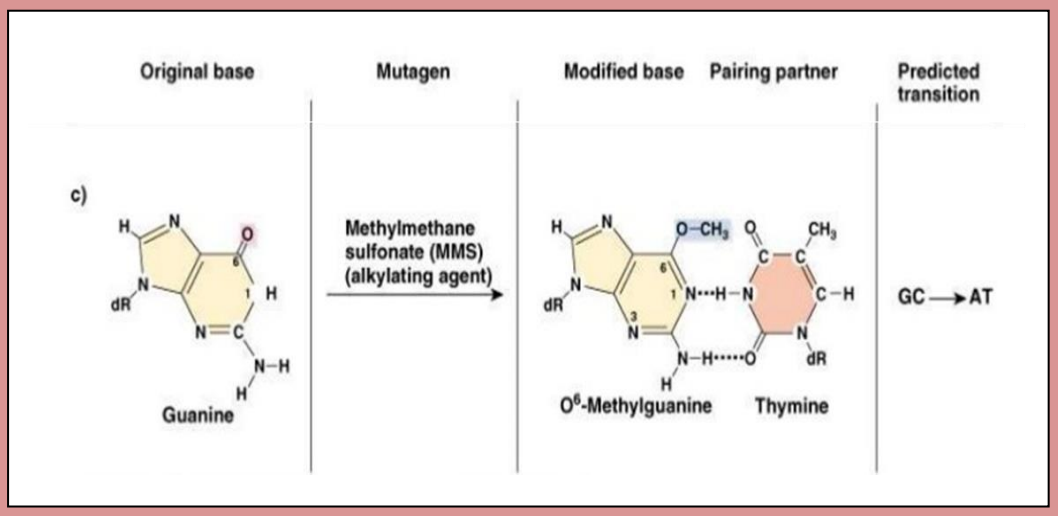



**Figure –** Function of alkylating agents

**Source - http://www.surendranathcollege.org (Page – 2)**

## Effects of Mutation

- ✓ **Harmful effects** – Changes in DNA caused by mutation in a coding region of DNA can cause errors in protein sequence that may result in partial or complete alteration in their function.

  E.g. – Inherited disorders, role in carcinogenesis.

- ✓ **Beneficial effects** – Although mutations that cause changes in protein sequences can be harmful to an organism, on occasions the effect may be positive in a given environment. In this case, the mutation may enable the mutant organism to withstand particular environmental stresses better than wild-type organisms, or reproduce more quickly. In these cases a mutation will tend to become more common in a population through natural selection.

  E.g. **–** HIV resistance, antibiotic resistance and lactase persistence.

**Source - https://en.wikipedia.org**

**(Disease causation and beneficial mutations)**

## INTERPRETATION AND CONCLUSION

The development and function of an organism is in large part controlled by genes. Mutations can lead to changes in the structure of an encoded protein or to a decrease or complete loss in its expression. Because a change in the DNA sequence affects all copies of the encoded protein, mutations can be particularly damaging to a cell or organism. Thus it can be concluded that mutation causes an important change in the nucleotide sequence of an organism which may be inheritable or non-inheritable, depending on the type of cells in which mutation have taken place. While most of these mutations prove to be harmful or deleterious in effect, few positive roles of mutations have also been discovered through research work.

Some of the negative mutations 18ecognized by the cells may be corrected through an inherent property of the cell i.e. the DNA repair mechanisms which includes processes such as the nucleotide excision repair , base excision repair , mismatch repair , recombinational repair , SOS response and many other such repair mechanisms. These mechanisms help to repair the damage caused due to mutation and thus help in transferring of the correct genetic sequence from one generation to the next.


## ACKNOWLEDGEMENT

Firstly, I would like to express my gratitude towards Dr. Purushottam Pramanik , Principal of Hooghly Mohsin College for conducting a seminar to enlighten ourselves. Secondly, I am highly grateful towards the Head of the PG Department of Botany , Hooghly Mohsin College , Dr. Debabrata Mukhopadhyay for giving me such a golden opportunity to present aseminar based on the topic Gene mutation. Also, I am highly thankful to all the other Professors of the PG Department of Botany who have helped me in the successful completion of this research work and providing me with facilities that were required.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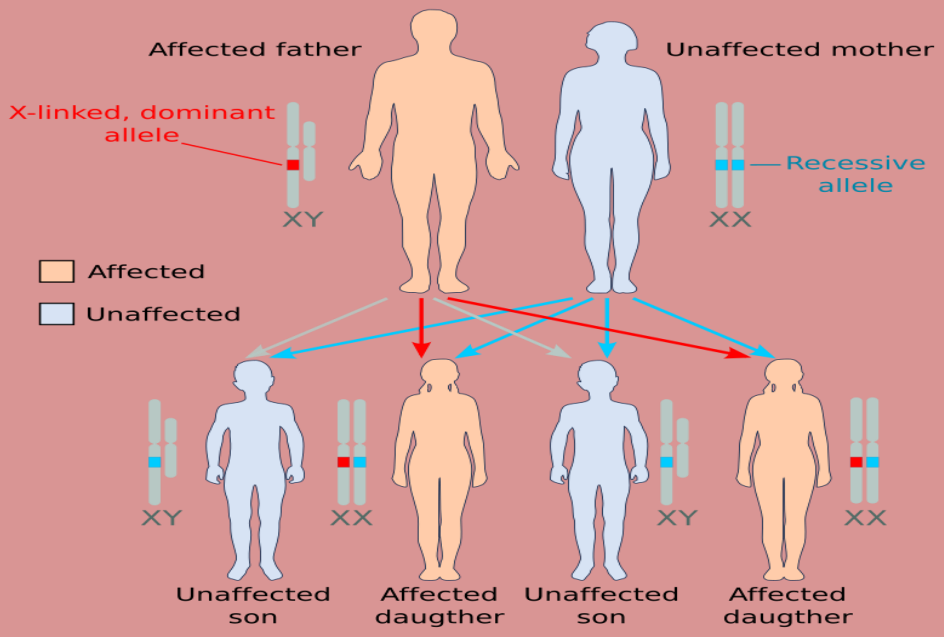
12. **https://en.wikipedia.org/wiki/Mutation#Disease_causation**

    **(Disease causation and beneficial mutations)**

**Paper- II**

# SEX LINKAGE

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## Abstract

Genes present on sex chromosomes determine the sex linkage phenomenon. It may be **X** linked or **Y** linked depending on the presence of **X** Chromosomes or Y chromosomes. **X** linked gene can appear in both male and female individuals, but Y linked gene can appear only in male individuals. The sex-linked gene may be recessive or dominant. Dominant sex-linked genes appear in all generations but recessive sex-linked gene may not be appear in all generation.

**Keywords:** Sex chromosomes, linkage, inheritance

## Introduction

Evidence to support the chromosome theory of heredity came in 1910 AD, when Thomas Hunt Morgan of Colombia University reported the result of genetics experiment with Drosophila. Morgan received the 1933 Noble Prize in Physiology or Medicine for "His discoveries concerning the role played by the Chromosomes in Heredity."

Linkage indicates the association of gene in the same chromosomes. These genes are inherited together and can be separated only by crossing over. The genes present on Sex Chromosomes provide the phenomenon of Sex Linkage. The study of inheritance of Sex Linkage provides some important information regarding the presence of character of gene in Sex chromosomes or autosomes.

### ❖ Sex chromosomes and autosomes

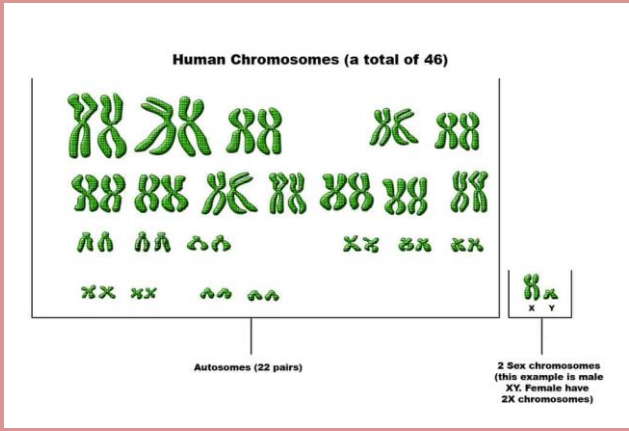


**Figure:** Autosomes and Sex chromosomes

**Source:** https://thednatests.com

- In *Drosophila*, man and many other similar organisms there are a pair of specialized chromosomes that are involved to determine the sex (male or female). The pairs of chromosomes are called Sex chromosomes, and the rest of chromosomes present in the cells are called autosomes. The sex chromosomes are designated as X and Y chromosomes.
- In male individual, the pairs of Sex chromosomes are Heteromorphic (XY) involving one X chromosome and one Y chromosome and in females it is Homomorphic (XY) with two X chromosomes.
- In birds this situation is just the reverse. The female has the heteromorphic pair of sex-chromosomes called ZW and male has Homomorphic pairs of Sex-Chromosomes ZZ.
- The traits which are carried by sex chromosomes are known as sex-linked traits and the genes which are present on Sex-chromosomes are called Sex-linked genes.
- Example-Eye color genes (red/white) in *Drosophila*, color blindness and Hemophilia genes in humans. (**Source :** i-Genetics, Peter J. Russell)

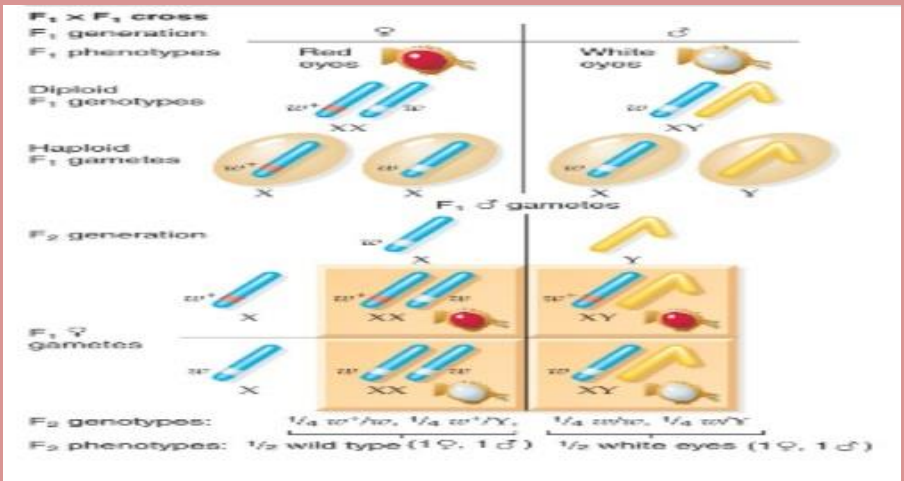


**Figure:** Inheritance of eye color in *Drosophila*, a cross between white eyed female and red eyed male.

## ❖ Inheritance of sex-linked genes

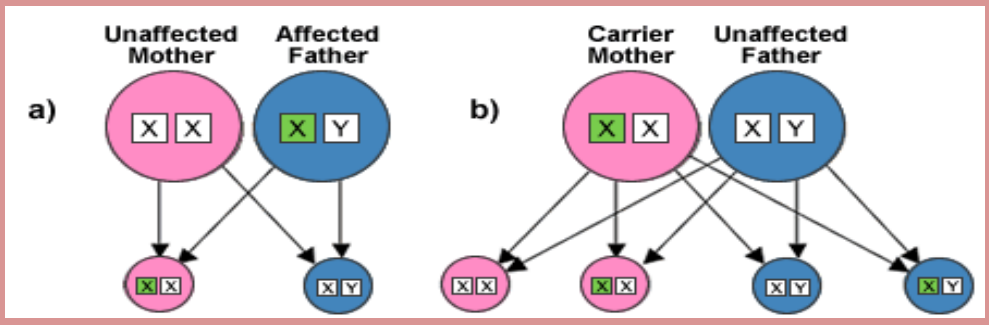


**Figure:** Inheritance of sex-linked genes (Criss Cross inheritance)

**Source**: https://www.toppr.com

- During crossing the X chromosome from male individual will always go to daughter. While chromosomes from female individual will go to both daughter and son.
- **The inheritance of characters from father to daughter (in F1) and daughter to grandson (in F2) in the next generation is called Criss Cross type of inheritance. (Source : i-Genetics, Peter J. Russell)**

**Example: If female parent carries recessive alleles in homozygous condition and male parent carries dominant alleles; the daughter will always show dominant phenotype and son will show the recessive phenotype.**

## ❖ Inheritance of Haemophilia Diseases in human

- Hemophilia is a recessive X-linked character of humans. Therefore heterozygous females are normal but carrier. Individuals suffering with this disease lack a factor responsible for blood clotting.
- Thus, blood clotting does not take place in individuals suffering from hemophilia disease and causing their death due to continuous bleeding.
- The carrier mother produces 50% normal son only and 50% son with Hemophilia disease. (**Source:** i-Genetics, Peter J. Russell)

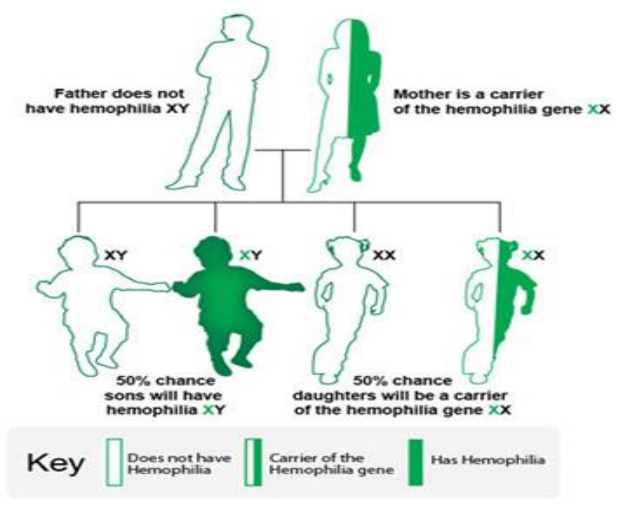


**Figure:** Inheritance of the disease haemophilia in human beings

**Source**: https://www.google.com

## ❖ Inheritance of Colorblindness Diseases in human

- It is a X-linked recessive character of humans. The individuals suffering from this disease cannot differentiate between red color and green color.
- If a colorblind man marries a girl who is normal (homozygous for this character), both the sons will be normal and 50% of the daughters will be normal but carrier.
- If a carrier girl marries a colorblind man then 50% of their daughters as well as 50% of their sons will be colorblind. (Source: i-Genetics, Peter J. Russell)

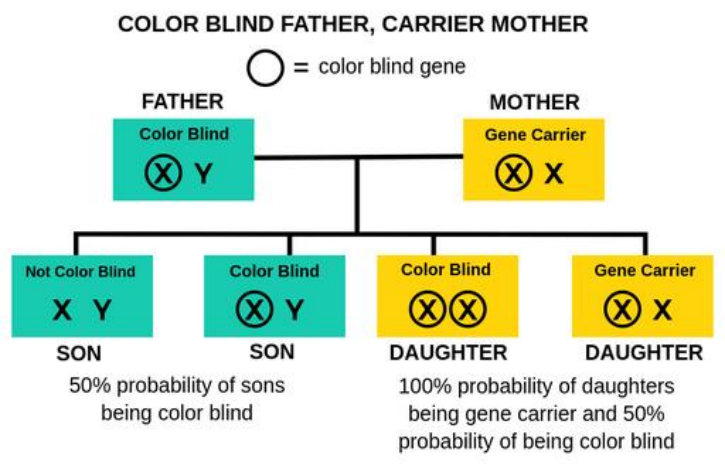


**Figure:** Inheritance of sex linked colorblindness blindness in humans

**Source:** https://theory.labster.com

## ❖ Sex influenced traits

- A sex-influenced trait is a trait controlled by a pair of alleles.
- It is found on the autosomal chromosomes **(in 1 pair out of the 22 pairs of autosomes)** but it's phenotypic expression is influenced by the presence of certain hormones such as **estrogen, progesterone, testosterone, etc**.
- Sex-influenced traits can be seen in both sexes, but will vary in frequency between the sexes or in the degree of the phenotypic expression.
- Example: **Baldness in Human, Horn in sheep.**
  **(Source:** https://www.slideshare.net)


**Figure:** Baldness influenced traits

**Source:** https://www.blogarama.com

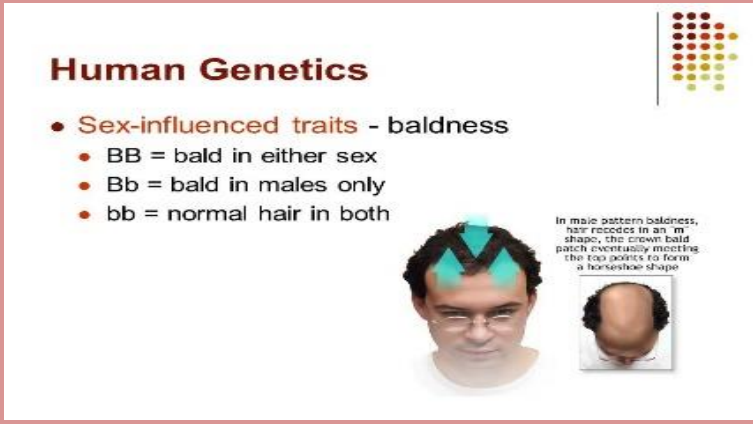


**Figure:** Sex influenced trait (Baldness in humans)

**Source**: https://socratic.org

## ❖ Sex Limited traits

• Sex limited traits are generally autosomal, which means they are not found on the **X** or **Y** chromosomes.

• The sex-limited traits are expressed in only one gender.

Example: beard growth, pregnancy - preeclampsia, Milk Production.

(**Source:** https://www.google.com)

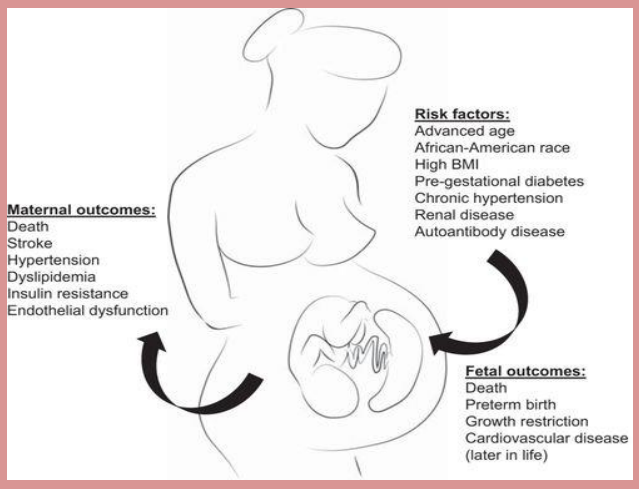


**Figure:** Sex limited trait

**Source**: https://journals.physiology.org

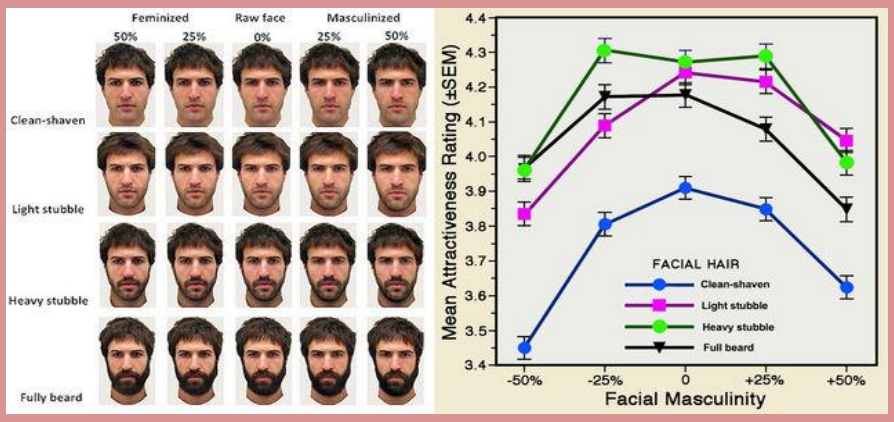


**Figure:** Sex limited trait (Beard development in man)

**Source:** https://www.psychologytoday.com

## Conclusion

- The study of sex linkage provides the knowledge how sex linked diseases are inherited from parents to their offspring.
- It also helps to control these diseases by selecting couples during marriage of individuals.
- Moreover, it also teaches about the different kind of sex-linked traits and their behaviors which make this a fabulous topic to read for the students.
- It helps us in the study of various diseases.

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- Dr. Samir kumar Paul,

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Lastly, I am grateful to the Almighty God and my parents, the author of my knowledge and wisdom, for the countless love.

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- www.wikipedia.com

## Paper- III

# A STORY OF CYTOKININ

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**Abstract:**

The cytokinins were discovered as a result of efforts to find factors that would stimulate plant cells to divide. The existence of growth factors that control plant cell division was postulated by J. Wiesner in 1892. G. Haberlandt, in 1913 and 1921, described the existence of putative substances that induced cell division. Folke Skoog and co-workers, at the University of Wisconsin, investigated the nutritional requirements for growth of plant tissue culture in the 1940s and early 1950s, and reported the activity of specific cell division factors in vascular tissue. Subsequently, the Wisconsin scientists examined various compounds from cells as potential sources of cell division factors. These investigations led Skoog, Miller and co-workers in 1955 to the isolation and identification of kinetin, a highly-active cell division factor, from autoclaved herring sperm DNA. In searching for naturally occurring cytokinins in plant tissues, Letham in 1963 isolated a cytokinin, zeatin, from immature corn kernels. A "kinetin-like" factor isolated by Miller in 1961 was later also identified as zeatin. Many phenylurea-derivatives have been shown to have cytokinin-like activity. Recent advancements in molecular biology now allow new insights into the mechanism of action of cytokinins and may yield unequivocal definition of the term "active cytokinin" and its signal transduction pathway(s).It has been recognized that cytokinins are plant hormones that influence not only numerous aspects of plant growth, development and physiology, including cell division, chloroplast differentiation and delay of senescence but the interaction with other organisms, including pathogens. Cytokinins are not only produced by plants but also by other prokaryotic and eukaryotic organism such as bacteria, fungi, microalgae and insects. Notably, cytokinins are produced both by pathogenic and also beneficial microbes and are known to induce resistance in plants against pathogen infections. In this review the contrasting role of cytokinin for the defence and susceptibility of plants against bacterial and fungal pathogen and pest insects is assessed. We also discuss the cross talk of cytokinins with other phytohormones and the underlying mechanism involved in enhancing plant immunity against pathogen infections and explore possible practical applications in crop plant production

## Introduction:

Cytokinins influence various traits of plant growth, development and physiology such as seed germination, apical dominance, flower and fruit development, leaf senescence and plant-pathogen-interactions etc. CKs are isoprenoid substituted adenines molecule. Isopentenyl transferases (IPTs) is the first enzyme involved in catalysing isoprenoid to other various types of CKs including cis-zeatin (cZ), N6-(Δ2-isopentenyl)-adenine (iP), trans-zeatin (tZ), and dihydrozeatin (DZ). In plants, tZ occur in the most abundant form. CKs are further metabolized and inactivated through conjugation to sugars or through degradation by CK oxidases (CKXs).

The type and activity of CK molecules differ remarkably between different plant species and tissues, at different developmental stages and under various environmental conditions. CKs are not only produced by plants but are also produced by plant associated microorganism, microalgae and insects. A role of CKs for interaction with insects is known for decades and the findings of CK mediated resistance against microbial pathogens in *Arabidopsis* (Choi et al., 2010) and tobacco (Grosskinsky et al., 2011) have been extended also to other species (Naseem et al., 2014; Siddique et al., 2015; Shanks et al., 2016; Dowd et al., 2017; Spallek et al., 2017).

## Discovery:

- Haberlandt (1913) – compound in phloem stimulates cell division.
- Van Overbeek (1941) – coconut milk (endosperm) also has the ability to stimulate cell division.
- Jablonski & Skoog (1954) – compounds in vascular tissues promote cell division.
- Miller (1955) – first cytokinin isolated from herring sperm named **kinetin.**
- Miller (1961) – first naturally occurring cytokinin found in immature endosperm of corn (*Zea mays*), later called **zeatin.**

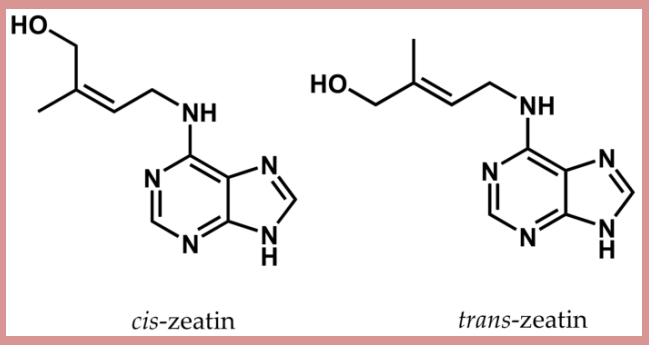


**Figure No.1** – Structure of cis-zeatin and trans-zeatin **Source** – Google

## Chemical Structure:

- Adenine structure (amino purine ring)
- $N^6$ Side chain
  - Degree of unsaturation
  - Number of carbons in side chain

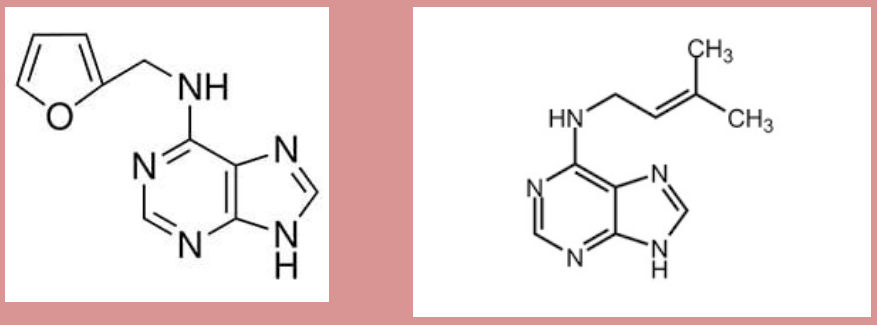


**Figure No. 2** – Structure of N6-[2-Isopentenyl] Adenine

**Source** - Google

- Free base forms are most hormonally active (Yamada et al. 2001)
- May have sugars attached to make molecule more inactive and useful for transport
  - Ribosides
  - Ribotides
  - Glycosides

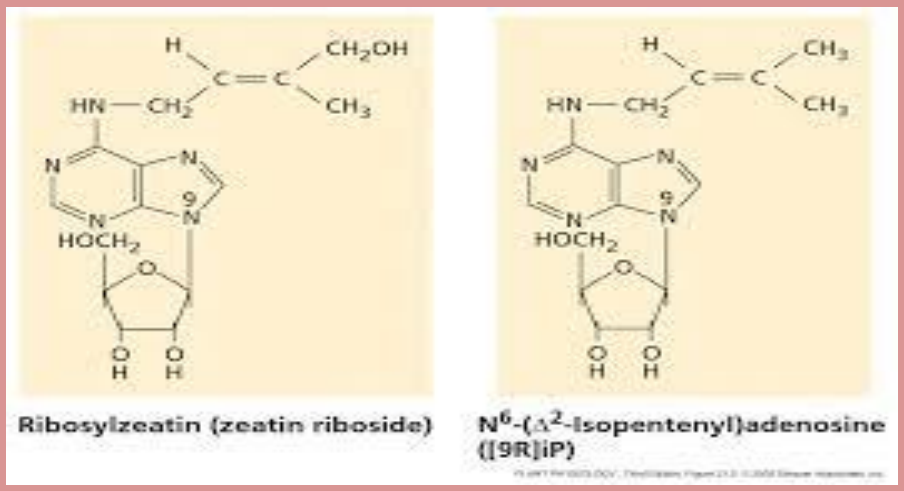


**Figure No. 3** – Structure of Ribosylzeatin **Source** - Google

**<u>Biosynthesis</u>**:

- Generated mostly in the **root apical meristems** but also found in

  - Root cap cells
  - Ovules
  - Phloem cells
  - Leaf axils
  - Tips of young inflorescences
  - Fruit
  - Seeds

**Transport:**

- Cytokinin move up the plant through the xylem
- By contrast, auxin moves from top down.
- Some signal in the shoot can also induce cytokinin transport from the root (Beveridge 2000).

**Functions:**

**Cell Division**

- Auxin and cytokinin influence the activity of:
  - Cyclin-dependant proteinkinases (CDKs) and cyclins

- Both are proteins that regulate transitions between G1 to S and G2 to mitosis stages in the cell cycle
  - Auxin stimulates the production of CDKs and cyclins.

  - Cytokinin activate CDKs and cyclins through phosphorylation and allow transition between stages.

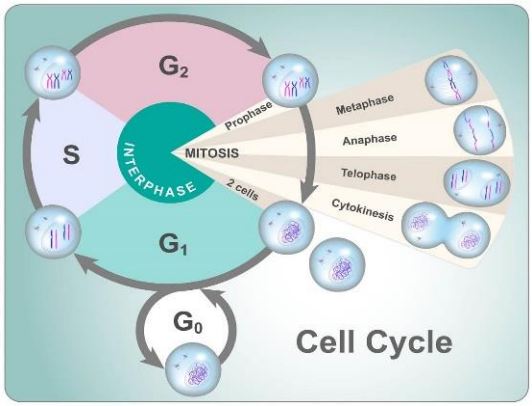


**Figure No. 4** – Stages of cell division **Source** - Google

**Root & Shoot Meristems**

Optimal levels of cytokinin are needed for normal cell division.

  - Root: cytokinin in abundance inhibits cell division (It is found in researches that endogenous cytokinin may negatively regulate root elongation)
  - Shoot: cytokinin promotes cell division

Cytokinin oxidase dictates meristem cytokinin concentrations.

  - Mutants can either overproduce or under produce this enzyme.


**Figure No .5** – Effect of cytokinin on root and shoot **Source** - Google

## Cell Differentiation

- Auxin: cytokinin affects cell differentiation in callus tissue.
- High CK and Low auxin à leads shoot induction.
- Low cytokinin and High Auxin à leads Root Induction.
- Equal amount of both lead to proliferation. After Skoog and Miller (1965)

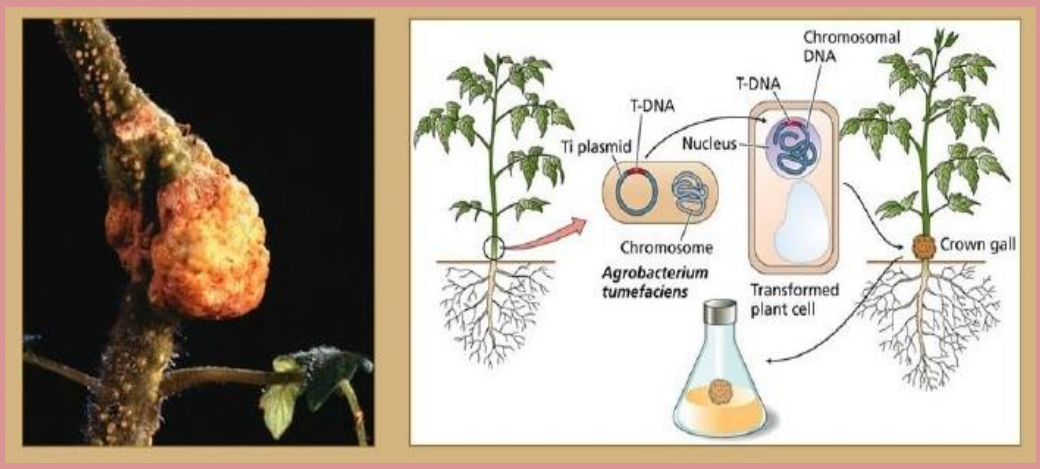


**Figure No. 6** - Cell differentiation using *Agrobacterium tumefaciens* **Source** - Google

## Leaf Senescence

Cytokinin delays leaf senescence

- The actual mechanism is not clear yet that how cytokinin is able to delay the leaf senescence but some evidence is found that it maintains the degradation ofchloroplasts and mobilize the proteins and Nutrients.
- May increase the growing season for agricultural purposes.
- This is also called Richmond-Lang Effect.

**Figure No. 7** - Effect of cytokinin on leaf and senescence **Source** - Google

## Inflorescence Growth

Cytokinin induce division in inflorescence tips

- Leads to more flowering which yields more fruit

"Cytokinin Oxidase Regulates Rice Grain Production" (Ashikari et al. 2005)

- Plants in this study have lower levels of cytokinin oxidase. The plants then produce more fruit.

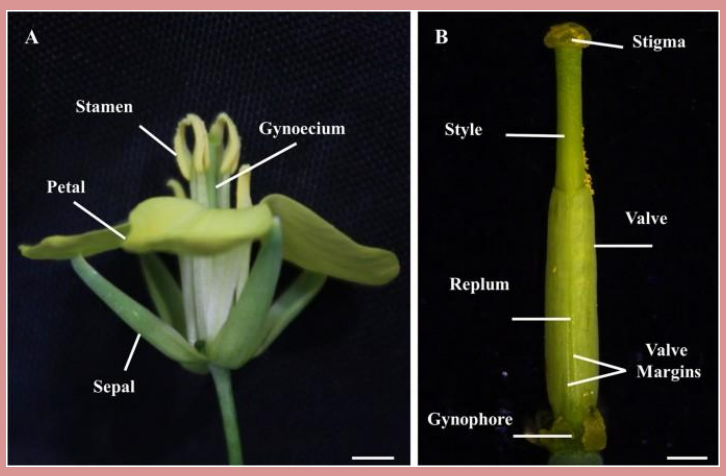


**Figure No. 8** – Effect of cytokinin showing infloresecence growth **Source** - Google

## Apical Dominance

- Antagonistic hormone interaction between cytokinin and auxin
  - Cytokinin stimulates growth inauxiliary buds

- Inhibits shoot elongation
  - Auxin restrains growth inauxiliary buds

- Causes shoot to lengthen.
- Mutants that overproduce cytokinin in lateral meristems are bushy.
- This technique is exercised by the tea gardener of Darjeeling and Assam and so on.

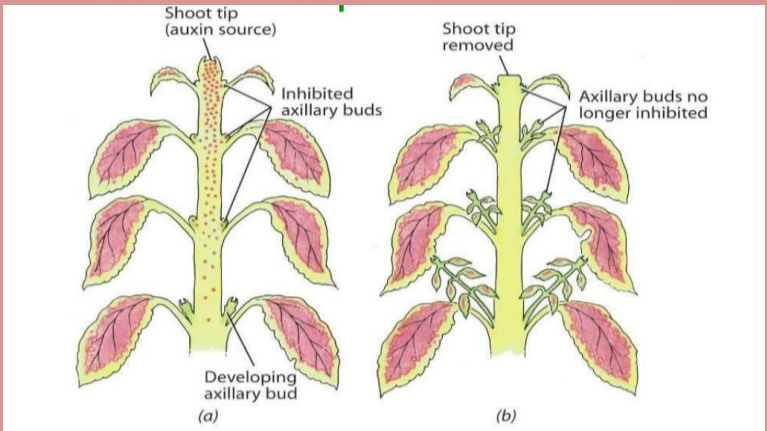


**Figure No. 9** – Figure showing apical dominance due to excessive presence of cytokinin

**Source** - Google

## Conclusion

This analysis of the consequences of reduced endogenous cytokinin content strongly indicates which plant processes cytokinins are limiting and might, therefore, have a regulatory function. The slowed formation of new cells in the SAM (shoot apical meristem), as well as of leaf primordia, and the reduced size of the SAM indicates that cytokinins have a dual function in the control of SAM proliferation. They are required to maintain the cell division cycle but might also be involved in promoting the transition from undifferentiated stem cells to differentiation. Earlier work has shown that in unorganized growing cells, cytokinins induce the formation of shoot meristems, demonstrating that they have a function beyond maintaining the cell cycle. The reduced activity of the SAM could also be the cause of incomplete apical dominance which was noted in transgenic plants as the amount of auxin produced for the maintenance of apical dominance might be lowered. The slowed formation of leaf cells and their reduced number indicates an absolute requirement for cytokinins during leaf formation, both to drive cell division cycle at normal speed and to obtain required number of divisions for a normal leaf size. That cytokinins function as a regulatory factor in leaf cell formation, is supported by the fact that transgenic *Arabidopsis* plants with an enhanced cytokinin content produced more leaf cells than control plantscytokinins have a negative regulatory function in root growth. The increased cell number in the transgenic root meristems and the slightly reduced final cell length in transgenic roots indicate that the enhanced root growth is because of an enhanced cycling of cells rather than increased cell growth. In the presence of lowered cytokinin content, root meristem cells have a prolonged meristematic phase and eventually undergo additional rounds of mitosis before they leave the meristem and start to elongate.

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- **Fig.1:**

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- **Fig.2:**

  https://www.google.com/search?q=N6-%5B2-Isopentenyl%5D+Adenine&sxsrf=ALeKk00Z2YAWuQF2X_mxP9yVEno8AbjaDA:1625866935074&source=lnms&tbm=isch&sa=X&ved=2ahUKEwjzs_eo-tbxAhU3wjgGHXm7DwEQ_AUoAXoECAEQAw&biw=1536&bih=664#imgrc=_k38QvE5ssBA9M

- **Fig.3:**https://www.google.com/search?q=ribosylzeatin&tbm=isch&ved=2ahUKEwiq3vTI3dbxAhUEk0sFHXpXC4AQ2-cCegQIABAA&oq=ribosylzeatin&gs_lcp=CgNpbWcQAzoHCCMQ6gIQJzoECCMQJzoFCAAQsQM6CAgAELEDEIMBOgIIADoGCAAQBRAeOgQIABAeOgQIABAYUJC9AljuhwNg6YoDaANwAHgAgAHvAYgB4RKSAQYwLjE0LjGYAQCgAQGqAQtnd3Mtd2l6LWltZ7ABCsABAQ&sclient=img&ei=kaToYOrRHoSmrtoP-q6tgAg&bih=722&biw=1536#imgrc=vPxPl91zoJ2PhM

- **Fig.4:**https://www.google.com/search?q=cell+division&sxsrf=ALeKk01AS9rjoKtxO3zaeVzQPQXu6Hw6Zw:1625860131241&source=lnms&tbm=isch&sa=X&ved=2ahUKEwjtxc384NbxAhXhzDgGHU03DLkQ_AUoAXoECAEQAw&biw=1536&bih=722#imgrc=iOL3C7cLQseLJM

- **Fig.5:**https://www.google.com/search?q=root+and+shoot+meristem+cytokinin+function&sxsrf=ALeKk01evYoFxJJPhydkZvwRXkXgOJN82w:1625860643093&source=lnms&tbm=isch&sa=X&ved=2ahUKEwjPp9fw4tbxAhVF3jgGHZ7rBg0Q_AUoAXoECAEQAw&biw=1536&bih=722#imgrc=3BwGAF5U1VxQFM

- **Fig.6:**https://www.pnas.org/content/98/18/10487

- **Fig.7:**https://www.google.com/search?q=%EF%83%98+Leaf+Senescence&sxsrf=ALeKk01730ZuiUoeDbqelsPRy9M7Q1wY_Q:1625861575906&source=lnms&tbm=isch&sa=X&ved=2ahUKEwiz6r2t5tbxAhXhxzgGHV6EDGoQ_AUoAXoECAEQAw&biw=1536&bih=664&dpr=1.25#imgrc=_e8psW6iTrb1SM

- **Fig.8:**https://www.google.com/search?q=%EF%83%98+Inflorescence+Growth+cytokinin&tbm=isch&ved=2ahUKEwi91J_v7NbxAhWIS30KHdhvCKoQ2-cCegQIABAA&oq=%EF%83%98+Inflorescence+Growth+cytokinin&gs_lcp=CgNpbWcQA1CREliSLmCSNGgAcAB4AIABoQGIAeALkgEEMC4xMJgBAKABAaoBC2d3cy13aXotaW1nwAEB&sclient=img&ei=nLToYL2WGoiX9QPY36HQCg&bih=664&biw=1536#imgrc=aIt3ZqwkSKr6YM

- **Fig.9:**https://www.google.com/search?q=apical+dominance+cytokinin&sxsrf=ALeKk02XRFLYzu4b6TgmP3bhb34szCgA4A:1625864044513&source=lnms&tbm=isch&sa=X&ved=2ahUKEwjQ0s3G79bxAhUgyDgGHf4RC0YQ_AUoAXoECAEQAw&biw=1536&bih=664#imgrc=0mWX4jyqCa1xgM&imgdii=DoIZ5FWuPaB-aM

**Paper- IV**

# NEW FACE OF ECOSYSTEM DURING CORONA PHASE

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## ABSTRACT

The outbreak of COVID-19 has made a global catastrophic situation that caused 1,039,406 deaths out of 35,347,404 infections and it will also cause significant socio-economic losses with poverty increasing from 17.1 to 25.9%. Although the spreading rate of COVID-19 was very high on October 6, 2020, the death rate was still less than 2.94%. Nonetheless, this review article shows that the lockdown has induced numerous positive impacts on the environment and on energy consumption. For instance, the lockdown has decreased the electricity demand by 30% in Italy, India, Germany, and the USA and by 12–20% in France, Germany, Spain and the UK. Additionally, the expenditure of the fuel supply had been decreased by 4% in 2020 as compared to the previous years (2012–2019). In particular, the global demand for coal fuel had been reduced by 8% in March and April 2020 as compared to the same time in 2019. In terms of harmful emissions, the lockdown reduced the emissions of nitrous oxides by 20–30% in China, Italy, France, Spain, and by 77.3% in São Paulo, Brazil. Similarly, the particulate matter level has been reduced from 5–15% in Western Europe, to 200% in New Delhi, India. In some places, such as New York, USA $CO_2$ emission was also reduced by 5–10%. The water quality in several polluted areas has also been remarkably enhanced, for example, the dissolved oxygen content in the Ganga River, India, has increased by 80%. Traffic congestion has also been reduced worldwide and in some areas it has been reduced by 50% such as New York and Los Angeles, USA. Overall, while the COVID-19 pandemic has shrinked the global economy by 13–32%, the pandemic has also clearly benefited to other sectors which must be considered as the spotlight for the permanent revival of the global ecosystem.

**Keywords:** COVID-19 benefits, Environmental regeneration, Renewable energy, Air pollution, Surface water, Traffic congestion

Figure –Air pollution

(Source- Google)

Figure- Water pollution

(Source- Google)

Figure- Wildlife

(Source- Google)

Figure – Plant

(Source- Google)

## INTRODUCTION

As we all know the spreading of Coronavirus brought the world to a standstill. I sympathize with the people who lost their loved ones. But we all must have heard that ***"***EVERY ***COIN HAS TWOSIDES."*** The same is happening with the earthlings. Our body needs detoxification after a certain limit.

**Nature** was in an urgent need to detoxify itself, to purify itself of all the junk that we are contributing to it in an unstoppable manner. Nature's purification process can be analyzed through the drastic decrease in pollution levels of air and water. The lockdown meant to curb the Coronavirus has helped significantly in cleaning the environment.

## ❖ EFFECT ON AIR

Figure- Effect on AIR
(Source- Google)

## A) PARTICULATE MATTER 2.5 OR PM 2.5 :


Figure- Particulate Matter 2.5 (Source- Google)

Particulate Matter 2.5 or PM 2.5 is generated in air from the harmful gases released from factories, industries and moving vehicles.

**It is world's deadliest air pollutant.**

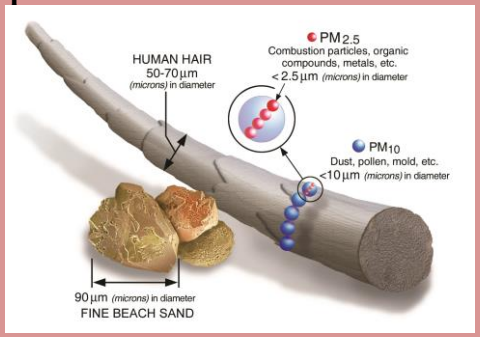


Figure - Understanding PM 2.5 and Air pollution control (Source- Google)

PM 2.5 falls under the Group I Carcinogenic category. It is so small that it can move into blood stream through lungs and can cause respiratory problems such as ASTHMA, HEART

ATTACK and even PREMATURE DEATH. WORLD HEALTH ORGANISATION ( WHO) estimated thatevery year in the whole world more than 4 million people dies due to lung disease , respiratory infection , chronic lung disease , lung cancer which is caused by PM 2.5 .But due to lockdown PM 2.5 has decreased +60% in air.(Source – Youtube)

**Instantaneous PM 2.5 levels over India on 28th April, 2019 and 2020**

Here we can see that in India, on 28thApril 2019 the level of PM 2.5 was high. But on 28th April 2020 i.e. during the lockdown period the level of PM 2.5 was highly reduced. This reduction in the level of PM 2.5 in air occurred because factories and industries were closed and there were few moving vehicles on roads due to lockdown.(Source- Youtube)

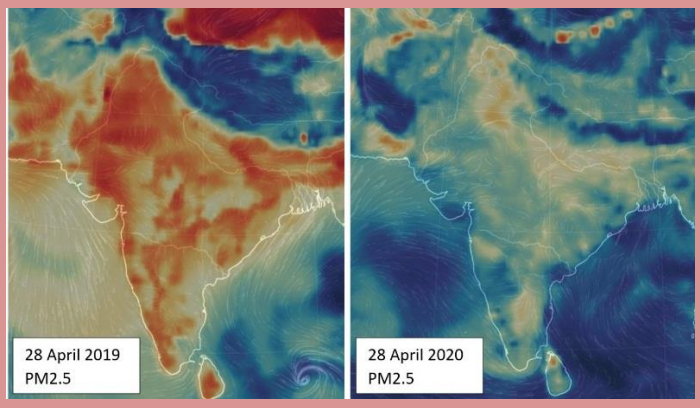


Figure- Instantaneous PM 2.5 levels over India on 28thApril2019 and 2020, (Source – Google)

**B) NITROGEN DIOXIDE :**

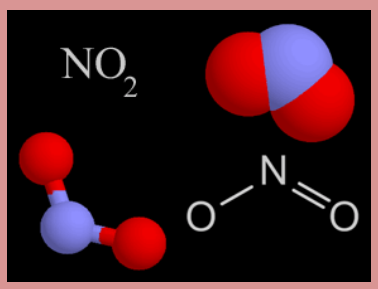


Figure- Nitrogen dioxide, (Source – Google)

Before lockdown $NO_2$ level was increasing rapidly in air in metropolitan cities. This compound is generated rapidly by affluent. Due to this, chance of acid rain was more. But due to lockdown industries are closed, thus there is no chance of acid rain.As per the reports from Indian Meteorological Department, the **level of $NO_2$ in metropolitan cities has decreased by 71%.**

Here, we can see the difference in the Mean Tropospheric $NO_2$ density in China in January 2020 and February 2020. The reduction in $NO_2$ density occurred during the lockdown period**.**( Source- Youtube**)**

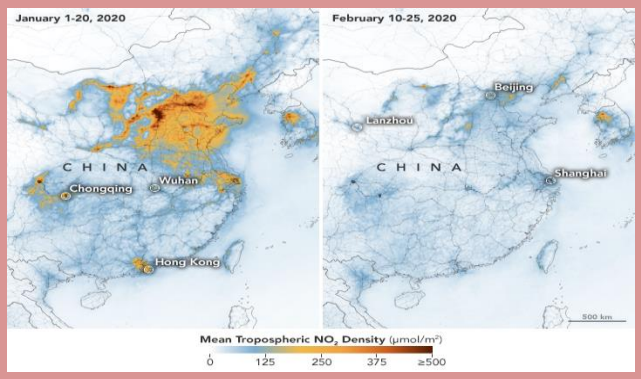


Figure- Changes in Mean Tropospheric $NO_2$ density (Source – Google)

There was lockdown in March 2020, in India and the level of $NO_2$ during this period was less which is shown on the map. Whereas, before and after lockdown, i.e., in March 2019 and March 2021 the level of $NO_2$ was high. ( Source- Youtube)

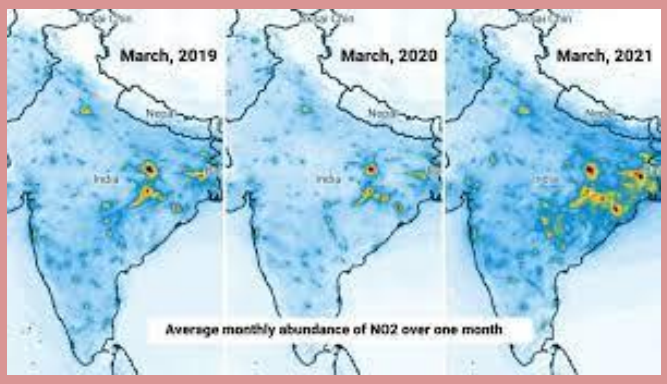


Figure- Changes in $NO_2$ density during March 2019,2020 and 2021, (Source – Google)

## C) OZONE LAYER :

Figure – Ozone Layer (Source – Google)

It acts as a shield for the Earth that protects living things from the harmful ultraviolet rays. But few years back, a hole was noticed in the ozone layer and it occurred due to Chlorofluorocarbon or CFCs which is released from industries. But during lockdown, as industries were closed no Chlorofluorocarbons were produced , thus the ozone layer began to repair itself .(Source- Youtube)

## NATURE REPAIRS ITSELF

## RECOVERY OF OZONE LAYER

Here , we see a clear picture that during lockdown the ozone layer began to repair itself.

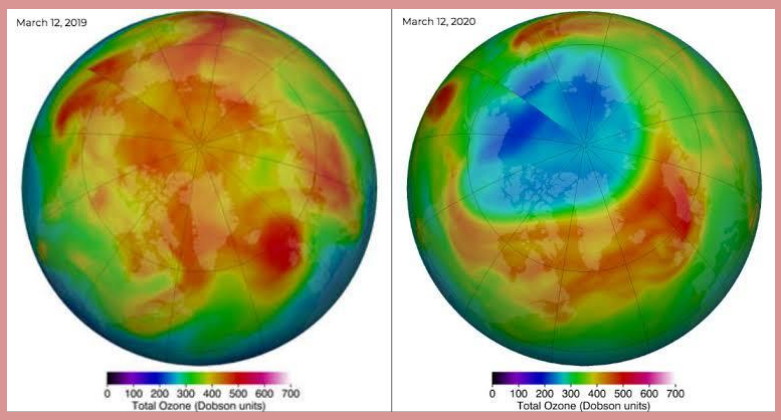


Figure- Recovery of Ozone layer (Source – Google)

## DETOXIFIED NATURE

Figure - Nature detoxifies itself (Source – Google)

In the recent years, air pollution was increasing day by day. But during lockdown, there was a drastic fall in the pollution level.

- Changes in air quality before and during lockdown in Milan, Venice and New Delhi is shown here. (Source – Youtube)


Figure- Difference in pollution level before and duing lockdown in Milan, Venice and New Delhi.(Source – Google)

- We get a clear idea from this picture that pollution level has decreased rapidly in Delhi during the lockdown phase.( Source-Youtube)

Figure- Pollution came under control during lockdown period (Source – Google)

- Residents of Mumbai breathes in fresh air during the lockdown period.

Figure- Drastic change in pollution level in Mumbai during lockdown phase. (Source – Google)

## EFFECT ON WATER

Figure- Effect on WATER (Source- Google)

Aquatic animals eat or gets entangled with plastics thrown in the water bodies and finally dies.

Figure- Aquatic animal life is in threat because of plastics thrown into water (Source – Google)

**Lockdown has played an important role in decreasing water pollution.**

The Ganges, the Yamuna and many other rivers were becoming polluted due to chemical wastes from industries. But after lockdown the scenario was something else.

- The Yamuna river before lockdown was filled with toxic foam. This toxic foam is harmful for aquatic life and produced when chemical wastes released from industries through sewage system mixes with water. ( Source- Youtube)

Figure – Toxic foam in the Yamuna river (Source – Google)

**A) CHANGES BEFORE AND DURING LOCKDOWN :**

- The Yamuna before the lockdown was filled with toxic foam but later during the lockdown period the water became clean and no toxic foam was seen as all industries were closed.

Figure- Changes before and during lockdown in the Yamuna river (Source – Google)

- Similar condition of the Ganges is seen here. Now during the lockdown period, the water is becoming cleaner day by day. ( Source – Youtube)

Figure- The Ganges before lockdown (Source – Google)

Figure – The Ganges during lockdown (Source – Google)

❖ **EFFECT ON WILDLIFE**

Figure – Effect on WILDLIFE (Source – Google)

**A) ANIMALS ARE MOVING FREELY IN INDIA:**

Wild animals took back what was once theirs as people were forced to stay home.

Figure -Animals are moving freely in India. (Source – Google)

**B) CHANGES BEFORE AND DURING LOCKDOWN:**

- There was an increase in the number of Flamingos congregating in Mumbai according to news report. (Source- Google)

Figure – Before lockdown in Mumbai (Source – Google)

Figure- After lockdown in Mumbai (Source – Google)

- Again, critically endangered Ganges dolphins made a return to the ghats of Kolkata.

Figure- Dolphins were not seen in the Ganges before lockdown

(Source – Google)

Figure - Dolphins were seen in the Ganges during the lockdown period

(Source – Google)

- The pristine beaches across the country's coastline became hatching grounds for tiny Olive Ridley Turtles. (Source- Google)
- Deer were seen to move freely on the roads in Japan.

Figure – Deer on the road in Japan (Source – Google)

- Sāmbhardeer were noticed to wander on the roads in Chandigarh.
- A herd of spotted deer explored the streets in Haridwar without the fear of being killed by moving vehicles.(Source- Youtube)

Decreased pollution levels in the cities has increased instances of wild animals in urban landscapes. The lockdown appeared to be a respite for Mother Earth to tend herself.

## ❖ EFFECT ON PLANT

Figure – Effect on PLANT ( Source- Google)

### A) POSITIVE SIDE OF LOCKDOWN :

In the recent years as pollution was increasing day by day, some plants like *Codiaeum variegatum* and*Rungia klossii* those were frequently noticed were turning out of sight. But during lockdown as pollution level was decreasing these plants were again seen to grow in abundance.

Figure – *Codiaeum variegatum*

(Source – Google)

Figure- *Rungia klossii*

(Source – Google)

❖ **EFFECT ON CLIMATE CHANGE**

Figure- Effect on CLIMATE CHANGE ( Source- Google)

❑ **TOTAL U.S. GREENHOUSE GAS EMISSIONS BY ECONOMIC SECTOR IN 2017:**

From this we can conclude that maximum Greenhouse Gas Emission occurs due to **TRANSPORTATION.**(Source- Youtube)

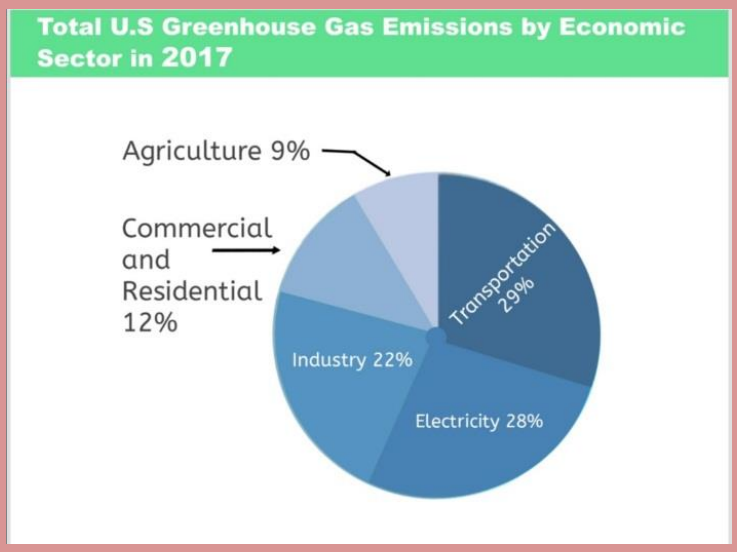


Figure – Total U.S Greenhouse Gas Emission by Economic Sector in 2017 (Source – Google)

We all know that Carbon dioxide is responsible for climate change as increase in Carbon dioxide leads to global warming. Transportation plays a major role in the emission of carbon dioxide. But due to lockdown emission of carbon dioxide due to transportation has been decreased. Experts predict that Lockdown could trigger biggest fall in carbon emission since World War II, approximately 5%.

## CONCLUSION

Lockdown also has positive sides . But lockdown cannot be continued for a longer period to control pollution. In order to cope up with this problem Government is planning to open plants to control pollution. We can even open industries that will use **RENEWABLE SOURCES OF ENERGY** instead of fossil fuels. Through these ways pollution can be undercontroll.

## ACKNOWLEDGEMENT

I, Pulama Mitra student of B. Sc. Botany Honours would like to thank my HOD Dr. Debabrata Mukhopadhyay and all other professors who gave me this opportunity to research and work on this topic. Through my research, I gathered a lot of information and came to know many things that I was unaware of. I shall ever remain grateful to all my professors.

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- https://youtu.be/-6c96JjDqrU
- https://youtu.be/hdAD3cjSRw4

**Paper- V**

# MULTIPLE ALLELISM

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## Abstract

Mendel implied that only two alleles, one dominant and one recessive, could exist for a given gene. We now know that this is an oversimplification. Although individual humans (and all diploid organisms) can only have two alleles for a given gene, multiple alleles may exist at the population level, such that many combinations of two alleles are observed. Note that when many alleles exist for the same gene, the convention is to denote that most common phenotype or genotype in the natural population as the **Wild type** (often abbreviated "+"). All other phenotype or genotype are considered variants (mutants) of this typical form, meaning they deviate from the wild type. The variant may be recessive or dominant to the wild type allele.

## Introduction:

Multiple Allele – when more than two different forms of given gene exist in a species they are called as multiple alleles.During his study on genetics, Mendel also assumed only two alleles of one trait.There can be large number of possible allelic forms in that same population. This situation is called as Multiple Alleles.

## Multiple Alleles?

When more than two alternative allelic forms of gene occupy the same loci in a pair of homologous chromosomes in the population, it is known as multiple alleles. Determination of a trait by more than two alleles is called multiple alleles. All the variants or alleles of a gene may have originated by mutation of a single wild type gene.

## Characteristics

Multiple alleles occupy the *same locus* within the homologous chromosomes. It means only one member of the series is present in a given chromosome. Since only two chromosomes of each type are present in each diploid cell, only two genes of the multiple series are found in a cell and also in a given individual. Crossing over does not occur in the multiple alleles. Multiple alleles control the same character, but each of them is characterized by different

manifestation. When any two of the mutant multiple alleles are crossed, the phenotype will be mutant and wild type.

## Multiple Alleles in Eye Colour of *Drosophila*

14 alleles for eye colour are found which produce various shades from white to red. Red eye colour is normal (wild type) - dominant to others, other shades are wine, coral, blood, cherry apricot, eosin, buff, tinged, honey, ecru, pearl, ivory and white.

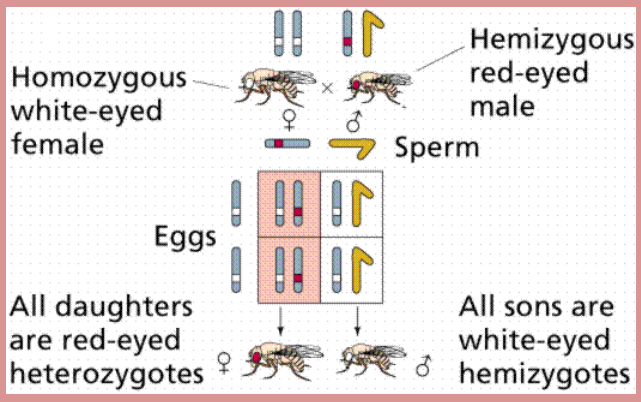



**Figure No. 1** – Figure showing multiple allele in eye colour of *Drosophila*

**Source** - Google

## A cross between any two mutant flies produce F1 hybrids having intermediate colour

For example: -

Pure Eosin Eye Colour  Pure white Eye Colour

Intermediate Pale Eosin Colour (F1generation) (100%hybrid)

This shows the **Incomplete Dominance** because the genes for eosin and white colour are neither dominant nor recessive.

## Multiple Alleles in Blood Groups

Human blood groups were reported by Dr. Karl Landsteiner in 1900. (Father of blood grouping) Presence of two types of proteins in human blood: -

- **Antigens or Agglutinogen**: - glycoprotein present on surface of RBCs called corpuscles factor.
- **Antibody or Agglutin**: - gamma-globulin present in blood plasma called plasma factor.

**Detection of A, B and O blood type in humans determined by multiple alleles and two alleles acting co-dominantly over third.**

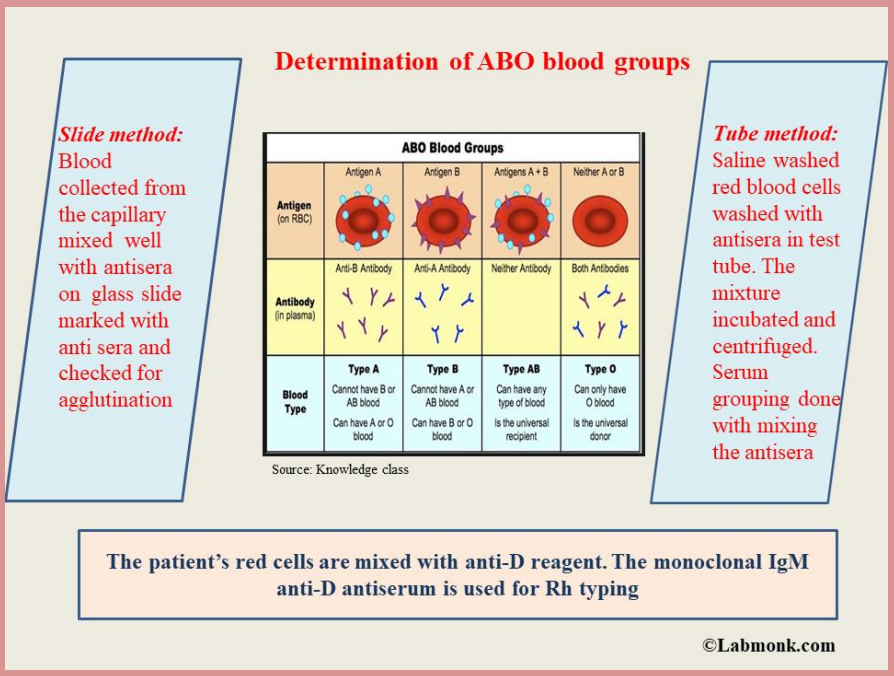



**Figure No. 2 –** Figure shows determination of ABO blood group in humans

**Source** - Google

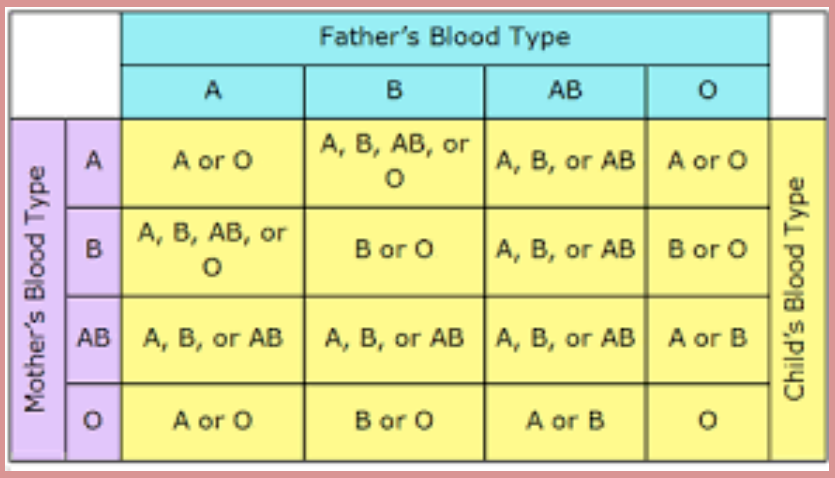
## Inheritance of ABO Blood Groups

Bernstein discovered that the ABO blood grouping is an inherited characteristic and involves multiple alleles.

| Phenotype | Genotype |
|---|---|
| Blood Type A | $I^AI^A$ or $I^Ai$ |
| Blood Type B | $I^BI^B$ or $I^Bi$ |
| Blood Type AB | $I^AI^B$ |
| Blood Type O | ii |

**Figure No. 3** – Figure showing inheritance of blood groups

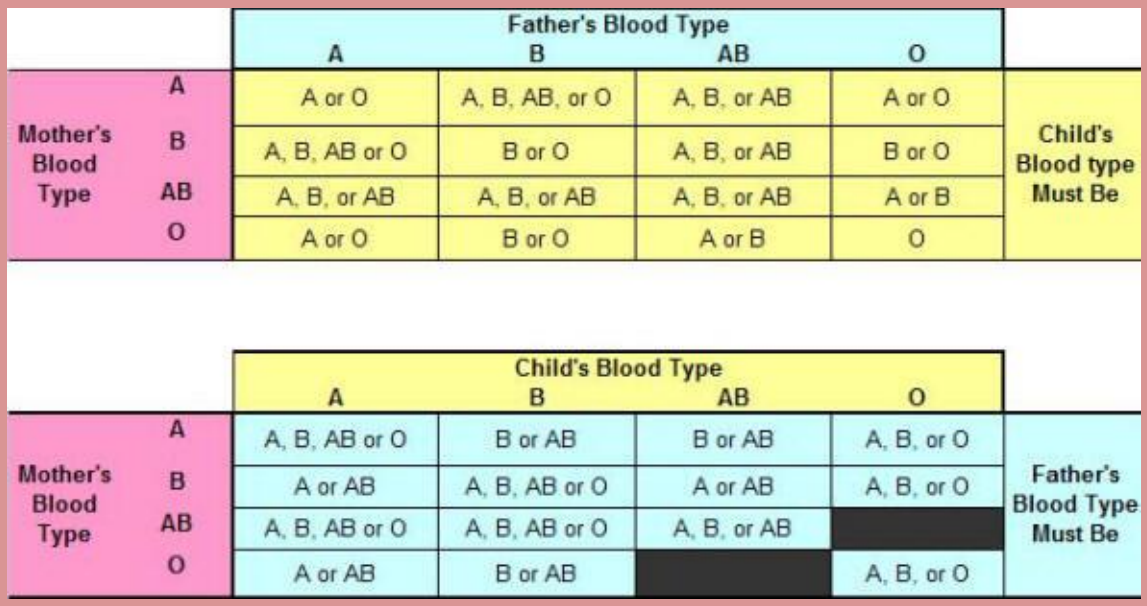
**Source** - Google



| Mother's Blood Type | Father's Blood Type: A | B | AB | O | Child's Blood Type |
|---|---|---|---|---|---|
| A | A or O | A, B, AB, or O | A, B, or AB | A or O | |
| B | A, B, AB, or O | B or O | A, B, or AB | B or O | |
| AB | A, B, or AB | A, B, or AB | A, B, or AB | A or B | |
| O | A or O | B or O | A or B | O | |

**Figure No. 4** – Inheritance of ABO blood group

**Source** - Google



| Mother's Blood Type | Father's Blood Type: A | B | AB | O | Child's Blood type Must Be |
|---|---|---|---|---|---|
| A | A or O | A, B, AB, or O | A, B, or AB | A or O | |
| B | A, B, AB or O | B or O | A, B, or AB | B or O | |
| AB | A, B, or AB | A, B, or AB | A, B, or AB | A or B | |
| O | A or O | B or O | A or B | O | |

| Mother's Blood Type | Child's Blood Type: A | B | AB | O | Father's Blood Type Must Be |
|---|---|---|---|---|---|
| A | A, B, AB or O | B or AB | B or AB | A, B, or O | |
| B | A or AB | A, B, AB or O | A or AB | A, B, or O | |
| AB | A, B, AB or O | A, B, AB or O | A, B, or AB | | |
| O | A or AB | B or AB | | A, B, or O | |

**Figure No.5** – Determination of blood groups in newly born child

**Source** - Google

## Conclusion:

Rishav Sharma (2021)- By studying Multiple Alleles we get to know that a population can have more than two alleles segregation at a locus and the alleles may have different relationship in different phenotype. This concept of Multiple Alleles is important in the context of evolution. There has to be an ability for alleles to change so that natural selection can occur thus leading to evolution. Within a population, there a many different allelic forms that can control phenotypic traits like for colour.

**Acknowledgement**

I would like to express my special thanks of gratitude to respected Principal of Hooghly Mohsin College Dr.PurushottamPramanik, for organising this seminar. Secondly, I would like to thank our respected Head of The Department Dr. Debabrata Mukhopadhyay, and other respected Professors of the PG Department of Botany who gave me the golden opportunity to do this wonderful seminar on the topic MULTIPLE ALLELES, which has also helped me in doing a lot of research work.

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- Figure No 1:

  https://www.google.com/search?q=A+cross+between+red+fly+and+any+mutant+fly+produces+F1+hybrid+flies+having+red+eye+colour+because+red+is+dominant+over+all+mutants&sxsrf=ALeKk00cal9S5Pev8-QRG3k-r32JreY_2w:1625682863993&source=lnms&tbm=isch&sa=X&ved=2ahUKEwjogoDNzNHxAhWiQ3wKHWJICqwQ_AUoAXoECAEQAw&biw=1536&bih=722#imgrc=9fbbBTMri1SXjM

- Figure No 2:

  https://www.google.com/search?q=detection+of+abo+blood+group&sxsrf=ALeKk01nhGPecFHH6bW7unJzXGrCAsbMIg:1625682981274&source=lnms&tbm=isch&sa=X&ved=2ahUKEwji1PaEzdHxAhWb4nMBHUwhDg8Q_AUoAXoECAEQAw&biw=1536&bih=722#imgrc=6PHmjWkM4FiGKM

- Figure No 3:

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- Figure No 4:

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- Figure No. 5:

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**Paper- VI**

# STRUCTURAL CHROMOSOMALABERRATIONS

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## ABSTRACT

The most important chromosomal changes contributing to evolution are structural alternations. Such chromosomal aberrations may involve duplication, deficiency or deletion, inversion and translocation. The hybrid showing such structural changes involving deletions, duplications, inversions and translocations are termed structural heterozygote. The most common examples of structural heterozygote are *Oenotheralamarckiana*and *Rhoeo discolor*. In *Oenotheralamarckiana*, no homozygous combinations survive, and the term balanced heterozygote or balanced lethal is used. All homozygote are lethal. The meiotic behavior of inversion and translocation are very characteristic, the former showing inversion bridges and the latter showing ring chromosomes in heterozygote. Deletions or duplications show loop formation.

The other type of aberrations includes centric fusion and fission. The former may give rise to metacentric chromosome from two acrocentric chromosomes; term used as Robertsonian fusion, whereas the latter leads to two telocentric chromosomes from a metacentric one. The telocentrics may give rise toisochromosomes with two identical arms. Sister chromatid exchange is another type of aberration involving interchange of DNA between sister chromatids. Such exchanges are often studied in relation to the effects of mutagen.

## INTRODUCTION

Structural chromosome aberrations are the result of chromosome breakage and abnormal reunion of broken chromosomes. They can be produced experimentally by exposing active cells to mutagens, such as ionizing radiation. However, spontaneous structural rearrangements in both somatic and germ cells arise from errors of recombination. Meiotic recombination is preceded by synapsis of homologous chromosomes, which involves the recognition by one homolog of complementary sequences in the other homolog. Mismatching can occur in this process, particularly at chromosomal sites containing tandem repeats of DNA sequences. This may result in duplication or deletion of the DNA at such sites. Similarly, synapsis between homologous sites on nonhomologous chromosomes may lead to accidental recombination between nonhomologous chromosomes, thereby leading to the transfer of chromosomal segments from one chromosome to another. These rearrangements are termed 'translocations' and the process has been renamed 'nonallelic homologous recombination'. Other mechanisms of rearrangement include nonhomologous end joining.

(Source- Google )

## DISCOVERY OF CHROMOSOMES

- Chromosomes were first described by Strausberger in 1875.
- The term "Chromosome", however was first used byWaldeyer in 1888.
- They were given the name chromosome (Chromo =color; Soma = body) due to their marked affinity for basic dyes.
- Their number can be counted easily only during mitotic metaphase.

(Source- Google )

## INTRODUCTION TO CHROMOSOMES

- Chromosomes are rod shaped or thread like condensed chromatinfibres which store and transmit coded hereditary information.
- The structure of chromosome consists of:
- 2 identical sister chromatides
- p Arm or short arm
- q Arm or long arm
- Primary constriction or centromere
- Secondary constriction
- Telomere
- Chromosomes are found in the nucleus of most living cells.
- They are the carriers of genetic information in the form of genes.
- Protein (histone) and DNA are the constituents of chromosome.
- Each human normally has 23 pairs of chromosomes, 46 in number.

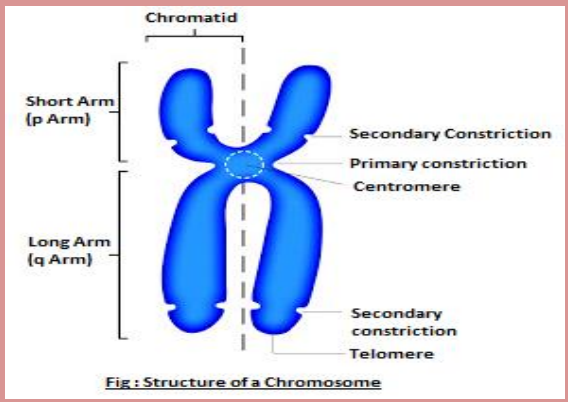


Figure- Structure of a Chromosome

(Source- Google)

## CHROMOSOMAL ABERRATIONS

- A chromosomal aberration, disorder, anomaly, abnormality, is a deleted, extra, or irregular portion of the chromosomal DNA.

- Chromosomal aberrations are caused due to mutations which result in change of the structure or number of chromosomes.
- The possible cause of such changes may be due to different types of radiation, nutritional misbalance, environmental changes, errors in cell division, etc.
- Generally, the incidence of chromosomal abnormalities is 5-6/1000 persons.
- Many children with a chromosomal abnormality have mental or physical birth defects.

(Source- Google)

## TYPES OF CHROMOSOMAL ABERRATIONS

Chromosomal aberrations are of two types: 1) Numerical chromosomal aberrations, which are of two types i] Euploidy (it involves the multiplication of entire set of chromosome) and ii] Aneuploidy (which involves the addition or loss of individual chromosome) and 2) Structural chromosomal aberrations, which is further divided into i] Deletion, ii] Duplication, iii] Inversion and iv] Translocation.

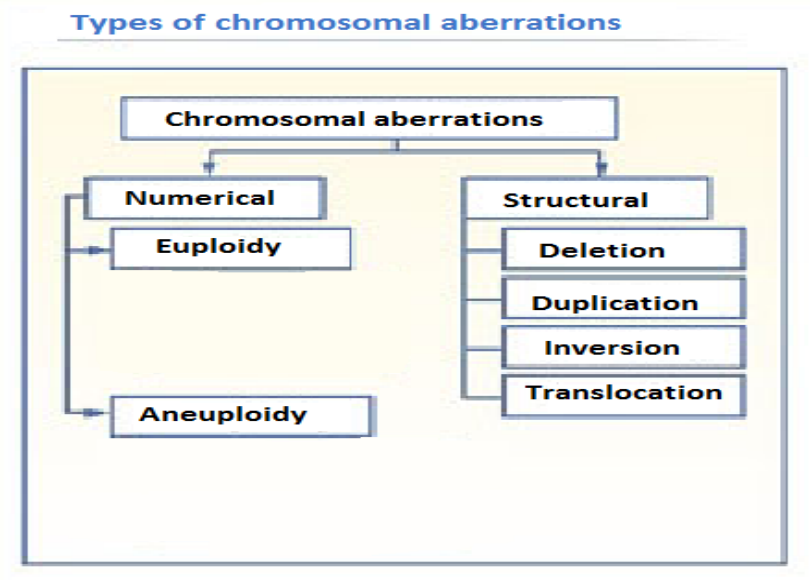


Figure – Types of Chromosomal aberrations

(Source- Google)

## STRUCTURAL CHROMOSOMAL ABERRATIONS

- Structural chromosomal aberrations are the result of chromosome breakage and abnormal reunion of broken chromosomes, i.e., the chromosomal aberrations in which they alters the structure of chromosome(sequence of genes or kind of genes in chromosome or no. of genes)

(Source- Google)

OR

- The mutations or changes that occur in structure of chromosome are structural aberrations.
- Also known as Chromosome Rearrangement.

(Source- Google)

## TYPES OF STRUCTURAL CHROMOSOMAL ABERRATION

**Common types of structural aberrations:-**

- Deletion or Deficiency
- Duplication
- Inversion
- Translocation

**DELETION OR DEFICIENCY**

- It was the first chromosomal aberration indicated by genetic evidences. This evidence, presented by Bridges in 1971 in Drosophila melanogaster, showed a deletion of the X chromosome that included the bar locus

  (Source-Cell Biology Genetics Molecular Biology, Dipak Kumar Kar, Soma Halder, page253)

- Deficiency or deletion represents a loss in chromosomal material.
- An event in which a piece of chromosome is missed or deleted.
- Can remove one or more genes from chromosome.
- Causes several serious genetic disorders.
- Deletion may occur due to:

(a) Losses from translocation
(b) Crossovers within an inversion
(c) Unequal crossing over
(d) Breaking without rejoining

( Source- Google )

- **TYPES OF DELETION**

**(i) Terminal Deletion**: - In this case loss of a terminal segment occurs, with a single break in the chromosomes.

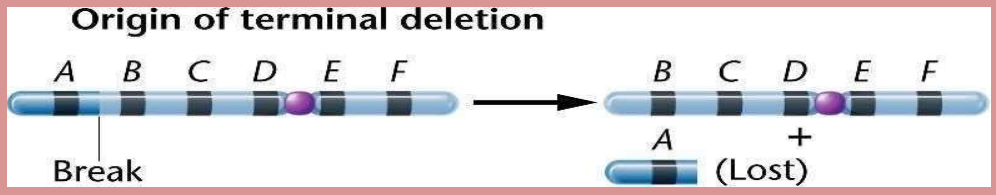


Figure- Origin of terminal deletion

(Source- Google)

**(ii) Intercalary deletion: -**. An intercalary chromosome deletion occurs when a segment of DNA is lost from the interior of a chromosome. Such a deletion involving may exhibit a deletion loop during meiosis I.

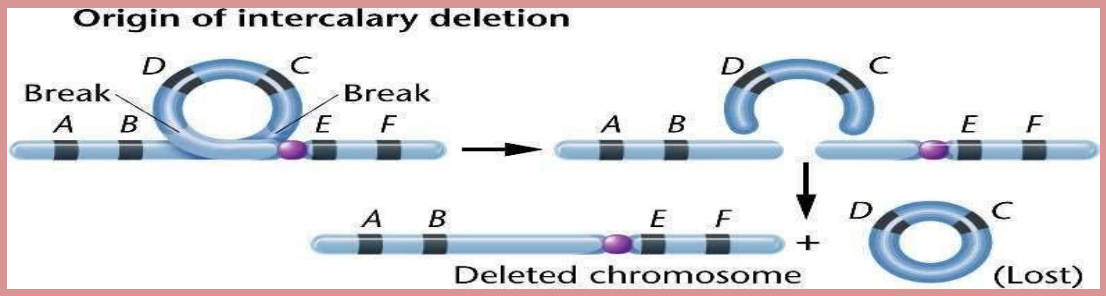


Figure- Origin of intercalary deletion

(Source- Google)

**DUPLICATION**

- Duplication is the doubling or repetition of a chromosomal segment. Here a segment may be present in more than two copies.
- As a result of it, a set of genes gets doubled or repeated
- The extra set of genes is generally called "***repeat***"
- Duplication was first detected by Bridges in 1919 from his genetic studies on X chromosome of Drosophila.

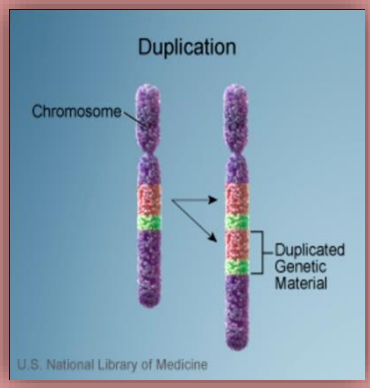


Figure- Duplication

(Source- Google)

## ➢ TYPES OF DUPLICATION

1. **Tandem Duplication:** The additional chromosomal segment located just after the normal segment, gene sequence being the same.

2. **Reverse tandem duplication:** The additional chromosome segment located just after the normal segment, but the gene sequence of the additional segment is inverted.
3. **Displaced duplication:** The additional segment is located in the same chromosome but away from the normal segment. It is of two types:~

I) Displaced homobrachial duplication – At a displaced position of the same arm.

II) Displaced heterobrachial duplication – On the different arm of the same chromosome.

4. **Transposed Duplication:** The additional segment located in a non-homologous chromosome.

( Source- Cell Biology Genetics Molecular Biology, Dipak Kumar Kar, Soma Halder,)

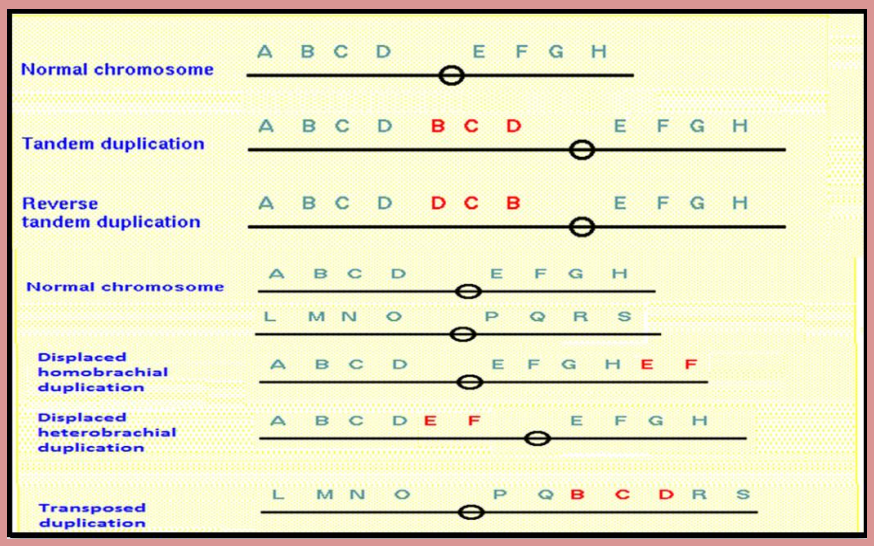


Figure- Types of duplication

(Source- Google)

**INVERSION**

- In this case, the fragment reattaches itself to theoriginal chromosome but in reverse orientation.
- OR, Inversion is the reversal of the linear order of a chromosome segment and its gene sequence.
- Chromosomal inversions may be Paracentric or Pericentric

➢ **TYPES OF INVERSION**

- **Paracentric inversion:** Here both breaks occur in one arm; The inverted segment does not contain centromere.

- **Pericentric inversion:**

Here breaks occur onboth arms; The inverted segment containscentromere.

( Source- Cell Biology  Genetics Molecular Biology, Dipak Kumar Kar, Soma Halder, )

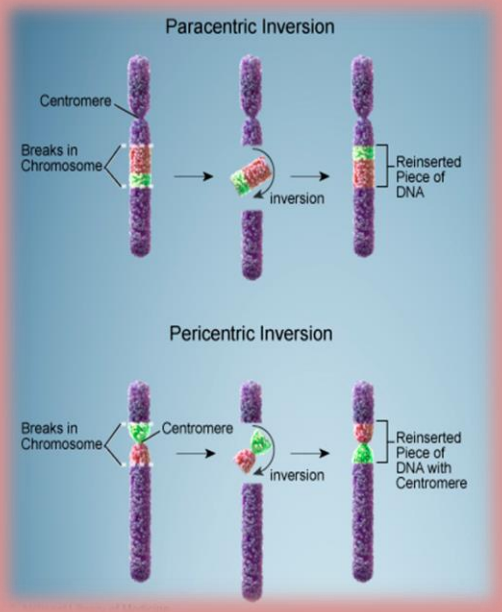


Figure- Paracentric and Pericentric Inversion

(Source- Google)

**TRANSLOCATION**

- Sometimes a part of a chromosome becomes detached and joins to a part of a non-homologous chromosome, thus producing translocation.
- Integration of a chromosome segment into a non-homologous chromosome is known as translocation.

- Translocation are of three types:

- Simple translocation or Terminal translocation
- Shift translocation or Interstitial translocation
- Reciprocal translocation

(Source-Cell Biology Genetics Molecular Biology, Dipak Kumar Kar, Soma Halder,)

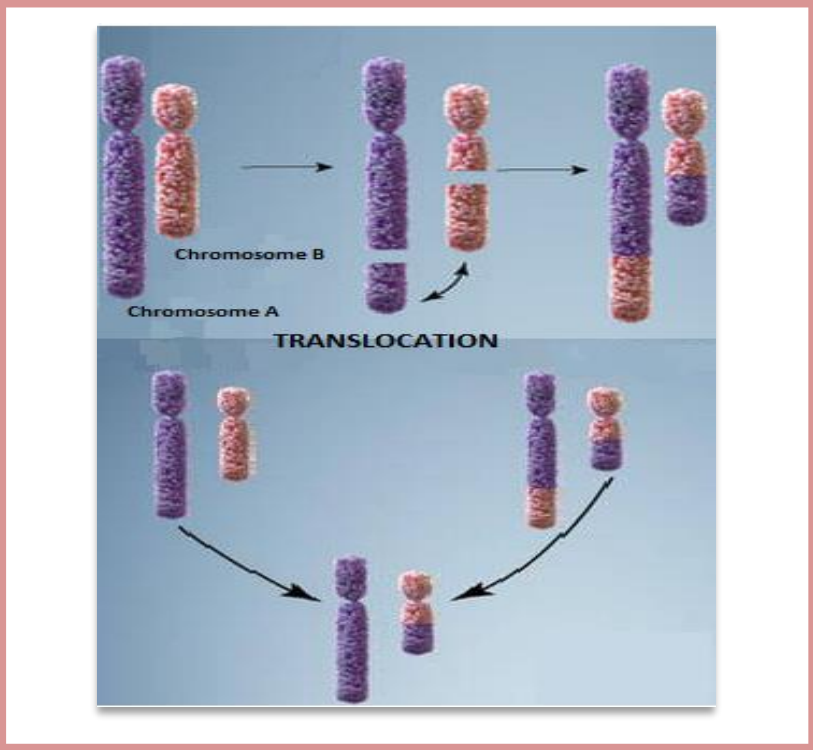


Figure – Translocation

(Source- Google)

➢ **TYPES OF TRANSLOCATION**

(a) **Simple translocation**: Here, terminal segment of a chromosome gets integrated to the same or the different chromosome.

(Source- Google)

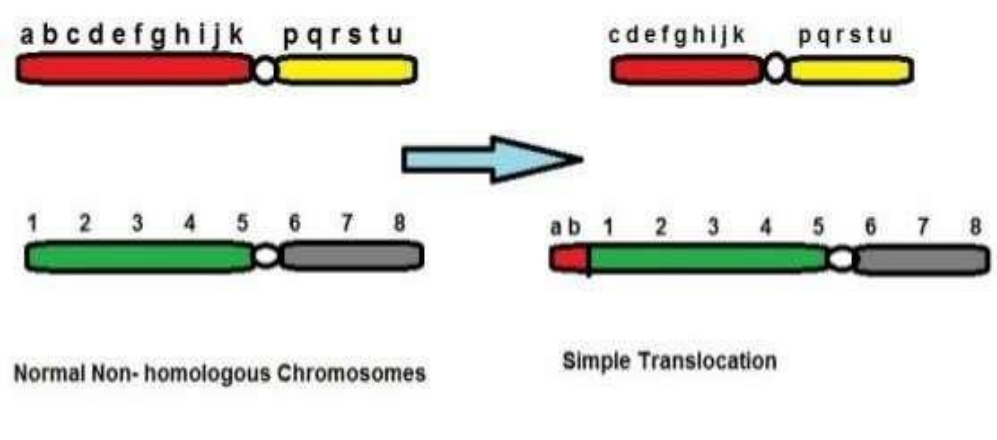


Figure- Simple translocation

(Source- Google)

(b) **Shift translocation:**Here an intercalary segment of a chromosome is interstitially integrated with a non-homologous chromosome.

(Source- Google)

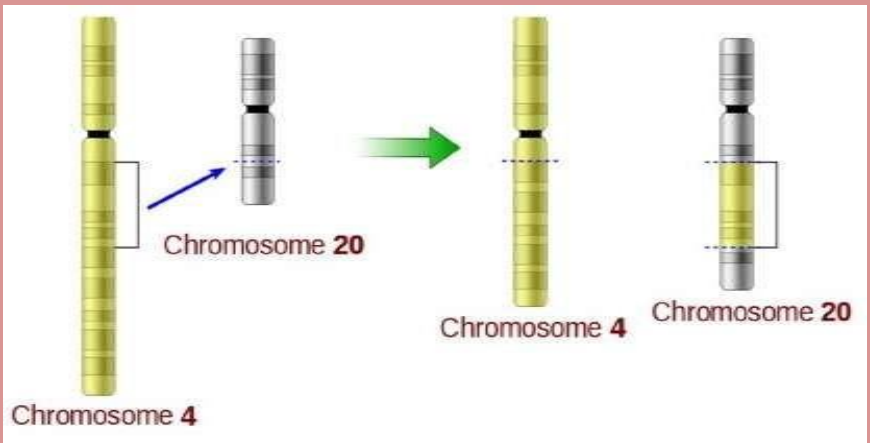


Figure-Shifttranslocation

(Source- Google)

(c) **Reciprocal translocation:** Here, two non-homologous chromosomes exchange their segments. This is the most common type of translocation.
(Source- Google)

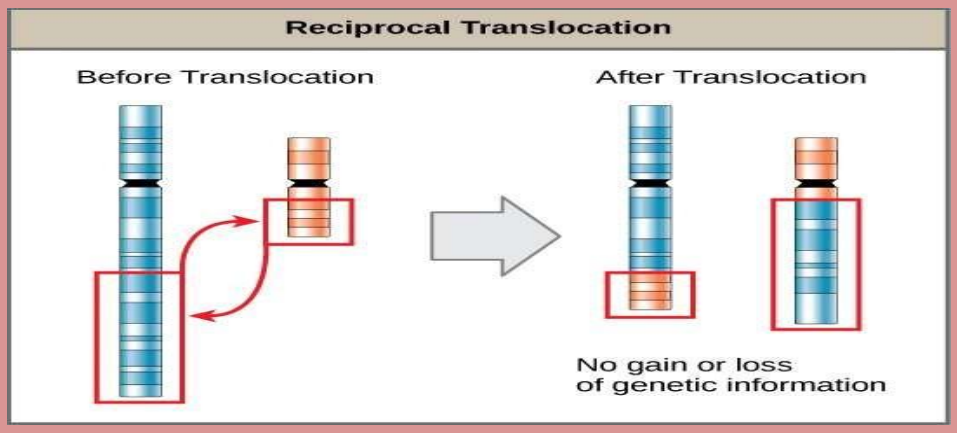


Figure- Reciprocal translocation

(Source- Google)

## USES OF STRUCTURAL CHROMOSOMAL ABERRATIONS

- Study of chromosome pairing and its behavior during cell division.
- For locating genes on particular chromosome.
- To resolve special problems such as relation between chiasma and crossing over.
- Used in plant breeding by increasing the dosage of certain desirable genes for increasing the activity.
- New genes can be produced through the process of duplications.
- Important role in evolution.
- Desirable characters can be detected using inversion.
- Translocation is used in determination of unknown locus of genes.
- Used to know the point of initiation of chromosome pairing.

(Source- Google)

## CONCLUSION

Structural aberrations also include some disorders which are characterized by chromosomal instability and breakage. One example is the creation of a fragile site on the X chromosome - Fragile X syndrome. Boys are worse affected by this because they only have one X-Chromosome but even in girls, Fragile X syndrome can cause learning difficulties.

Diseases caused due to Deletion are Cri-du-chat syndrome, Jacobsen syndrome; effects of deletion are pseudodominance and haploid insufficiency. Diseases caused due to duplication are Pallister-Killian syndrome, Charcot-Marie-Tooth disease type 1A; effect of duplication is Bar eye in drosophila. Several forms of cancer are caused by acquired translocation, this has been described mainly in Leukemia. XX male syndrome is also caused by translocation of SRY gene from the Y to the X chromosome.

According to me4, the most harmful aberration is Deletion, as it can be never cured, because in this case a part of chromosome is vanished.

## ACKNOWLEDGEMENT

In preparation of my eBook, I had to take the help and guidance of some respected persons, who deserve my deepest gratitude. As the completion of this eBook gave me much pleasure, I would like to show my gratitude to Dr. DebabrataMukhopaddhay, Head of the Department of PG Department of Botany, Hooghly Mohsin College, for giving me a good guidelines for preparing the eBook. I would also like to expand my gratitude to all those who have directly and indirectly guided me in writing this assignment.

In addition, a thank you to Professors Dr. Dipan Adhikary, Dr. Manasi Aditya and Dr. Biswajit De, who introduced me to the topic of my paper as well as to the Methodology of work, and I also thank the Hooghly Mohsin College for this concept of eBook.

Many people, especially my classmates have made valuable comment suggestions on my paper which gave me an inspiration to improve the quality of the assignment.

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- Causes of Deletion: https://www.slideshare.net/AsadAfridi5/structural-chromosomal-aberrations-change-in-structure-of-chromosome slide17
- Definition of DELETION: Cell Biology Genetics Molecular Biology, Dipak Kumar Kar, Soma Halder, page253
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- Discovery of chromosomes: https://www.slideshare.net/AsadAfridi5/structural-chromosomal-aberrations-change-in-structure-of-chromosome?qid=a71e187f-46b5-458f-b6c9-082be4c3fbc2&v=&b=&from_search=7#:~:text=Structural%20Chromosomal%20aberrations,are%20also%20included. Slide 7
- Figure of chromosome: http://realhistoryww.com/world_history/ancient/Misc/Albinism_simple/Albinism_for_Dummies.htm#:~:text=This%20is%20a%20graphic,double%20helix%20of%20DNA.)
- Figure of Intercalary deletion: https://bio3400.nicerweb.com/Locked/media/ch08/chromosome_deletion-intercalary.html#:~:text=occurs%20when%20a%20segment%20of%20DNA%20is%20lost%20from%20the%20interior%20of
- Structural chromosomal aberration: https://www.slideshare.net/AsadAfridi5/structural-chromosomal-aberrations-change-in-structure-of-chromosome slide 13

- Terminal Deletion figure: https://www.slideshare.net/AsadAfridi5/structural-chromosomal-aberrations-change-in-structure-of-chromosome slide 19

- Duplication: https://www.slideshare.net/AsadAfridi5/structural-chromosomal-aberrations-change-in-structure-of-chromosome slide 21

- Figure of Duplication:https://medlineplus.gov/images/PX000070_PRESENTATION.jpeg

- Figure of types of Duplication: http://home.cc.umanitoba.ca/~frist/PLNT3140/l19/l19.html#:~:text=chromosome%20segment%20attached,Types%20of%20duplications

- Figure of types of inversion: https://medlineplus.gov/genetics/understanding/mutationsanddisorders/structuralchanges/#:~:text=occurs%20when%20a%20chromosome,inversion.%20An%20inversion%20that

- Inversion: https://www.slideshare.net/AsadAfridi5/structural-chromosomal-aberrations-change-in-structure-of-chromosome

- Simple translocation, Shift translocation, Reciprocal translocation and their figures: https://www.slideshare.net/InduSharma62/structural-chromosomal-aberration? Slide 12, 13

- Types of Duplication: Cell Biology Genetics Molecular Biology, Dipak Kumar Kar, Soma Halder, page252
- Types of inversion: Cell Biology Genetics Molecular Biology, Dipak Kumar Kar, Soma Halder, page252

- Translocation types: Cell Biology Genetics Molecular Biology, Dipak Kumar Kar, Soma Halder, page257

- Translocation figure: https://medlineplus.gov/genetics/understanding/mutationsanddisorders/structuralchanges/#:~:text=translocation%20occurs%20when%20a%20piece%20of%20one%20chromosome%20breaks%20off%20and%20attaches%20to%20another%20chromosome.%20This%20type%20of%20rearrangement
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**Paper-VII**

# APPLICATIONS OF BIOTECHNOLOGY

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SEMESTER: 6th

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**ABSTRACT**

Biotechnology is a technology that utilizes biological systems, living organisms or parts of this to develop or create different products. With the development of genetic engineering in the 1970s, research in biotechnology (and other related areas such as medicine, biology etc.) developed rapidly because of the new possibility to make changes in the organisms' genetic material (DNA).Biotechnology deals with industrial scale production of biopharmaceuticals using genetically modified microbes, fungi, plants and animals.Biotechnology is a broad field that deals with the exploitation of living organisms to develop products beneficial for sustainable development. It harnesses cellular and molecular processes to develop products and technologies that could help in improving human life on earth. It has a variety of applications that focus on human welfare.

KEYWORDS: Medicine, Agriculture , Pest -resistance

## INTRODUCTION

Biotechnology is applied to various fields and many industries such as food, pharmaceuticals, medicine, agriculture, etc. It has its scope in both research and engineering.

Genetic engineering has helped in the production of therapeutic proteins as well as biological organisms. Biotechnology has made major advances in molecular biology and industrial biotechnology.

The scope of biotechnology is extended to various branches of biology. Some of these include tissue culture, development of transgenic plants and animals, development of antibodies, etc. USA itself has established more than 200 companies such as Biogen, Cetus, Hybritech, etc.

Biotechnology is the research and development in the laboratory using bioinformatics for exploration, extraction, exploitation and production from any living organisms and any source of biomass by means of biochemical engineering where high value-added products could be planned (reproduced by biosynthesis, for example), forecasted, formulated, developed, manufactured, and marketed for the purpose of sustainable operations and gaining durable patents rights (for exclusives rights for sales, and prior to this to receive national and international approval from the results on animal experiment and human experiment, especially on the pharmaceutical branch of biotechnology to prevent any undetected side-effects or safety concerns by using the products).

## APPLICATIONS OF BIOTECHNOLOGY IN AGRICULTURE

- Genetically Modified Organisms
- Genetically Modified plants ( Golden Rice )
- Genetically modified biopesticide ( Bt cotton)
- Pest resistant plants

### Genetically Modified Organisms (GMO):

Plants, bacteria, fungi and animals whose genes have been altered by manipulation are called Genetically Modified Organisms (GMO). GM plants have been useful in many ways. Genetic modification has:

- Made crops more tolerant to abiotic stresses (cold, drought, salt, heat).
- Reduced reliance on chemical pesticides (pest-resistant crops).
- Helped to reduce post harvest losses.
- Increased efficiency of mineral usage by plants (this prevents early exhaustion of fertility of soil).
- Enhanced nutritional value of food, e.g., golden rice, i.e., Vitamin ‘A’ enriched rice.
  (Source- Google)

### GENETICALLY MODIFIED PLANTS:- GOLDEN RICE

- Golden rice is a variety of rice (*Oryza sativa*) produced through genetic engineering to biosynthesize beta-carotene, a precursor of vitamin A, in the edible parts of rice.
- It is intended to produce a fortified food to be grown and consumed in areas with a shortage of dietary vitamin A, a deficiency which each year is estimated to kill 670,000 children under the age of 5 and cause an additional 500,000 cases of irreversiblechildhood blindness.
- Rice is a staple food crop for over half of the world's population, providing 30–72% of the energy intake for people in Asian countries, and becoming an effective crop for targeting vitamin deficiencies.
- Golden rice differs from its parental strain by the addition of three beta-carotene biosynthesis genes
  (Source- Google)

Figure- Golden rice, (Source- Google)

**Genetically modified biopesticide:**

- Bt toxin is produced by a bacterium called Bacillus thuringiensis (Bt for short).
- Bt toxin gene has been cloned from the bacteria and been expressed in plants to provide resistance to insects without the need for insecticides
- Examples are Bt cotton, Bt corn, rice, tomato, potato and soybeanetc.

**Bt Cotton**

Some strains of *Bacillus thuringiensis* have proteins that kills insect like coleopterans (beetles), lepidopterans (tobacco budworm , armyworm) & dipterans (flies, mosquito).*B. thuringiensis* forms a toxic insecticidal protein (bt toxin) crystal during a particular phase of their growth.It doesn't kill the bacillus as it exist as inactive protoxin.When an insect ingests the inactive toxin, it is converted into active toxin due to alkaline pH of the gut, which solubilisesthecrystal. Thetoxins bind to the surface of midgut epithelial cells and create pores and causes cell swelling and lysis and death of the insect.Protein encoded by genes are, cryIAc&cryIIAb, control the cotton bollworms.

(Source- Google)

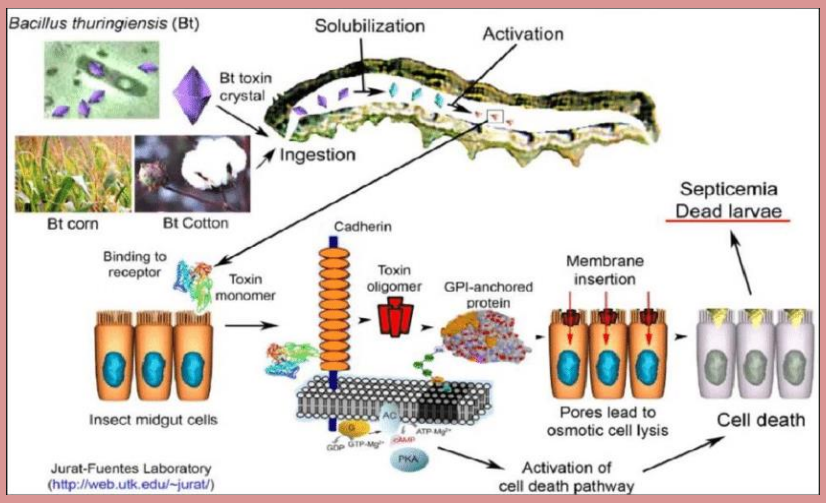


Figure- Mechanism of *Bacillus thuringiensis* , (Source- Google)

**PEST RESISTANT PLANT**:

Several nematodes parasitize a wide variety of plants and animals including human beings.

A nematode *Meloidogyne incognita* infects the roots of tobacco plants and causes a great reduction in yield.

A novel strategy was adopted to prevent this infestation which was based on the process of RNA interference (RNAi).

RNAi takes place in all eukaryotic organisms as a method of cellular defense.

This method involves silencing of a specific mRNA due to a complementary dsRNA molecule that binds to and prevents translation of the mRNA (silencing).

Figure- Infection in tobacco plant , (Source- Google)

**APPLICATIONS OF BIOTECHNOLOGY IN MEDICINE**

APPLICATIONS OF BIOTECHNOLOGY IN MEDICINE HAS REACHED A CERTAIN HEIGHT IN RECENT YEARS BY THE USE OF LIVING CELLS AND CELL MATERIALS TO RESEARCH AND PHARMACEUTICAL AND DIAGNOSTIC PRODUCTS THAT HELP TO TREAT PEOPLE AND PREVENT DIESEASES.

SOME OF THEM ARE:-

DNA FINGERPRINTING

GENETICALLY ENGINEERED INSULIN

GENE THERAPY

MOLECULAR DIAGNOSIS

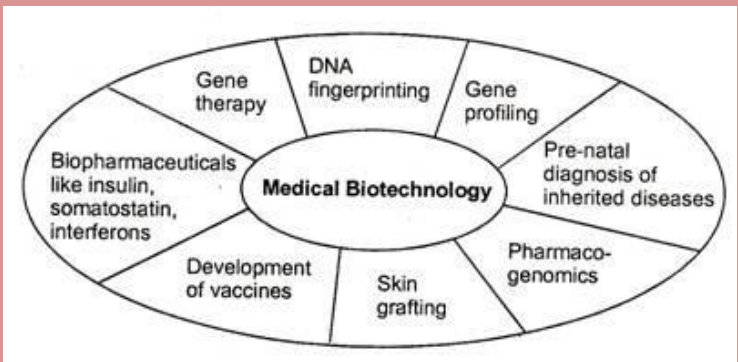


Figure- Applications of biotechnology in medicines, (Source- Google)

## GENETICALLY ENGINEERED INSULIN:

Management of adult-onset diabetes is possible by taking insulin at regular time intervals.Insulin consists of two short polypeptide chains: chain A and chain B that are linked together by disulphidebridges.In mammals, including humans, insulin is synthesized as a pro-hormone.Like a pro-enzyme, the pro-hormone also needs to be processed before it becomes a fully mature and functional hormone, containing an extra stretch called the C peptide.C peptide is not present in mature insulin and is removed during maturation into insulin.The main challenge for production of insulin using rDNA techniques was getting insulin assembled into a mature form.

(Source- Google)

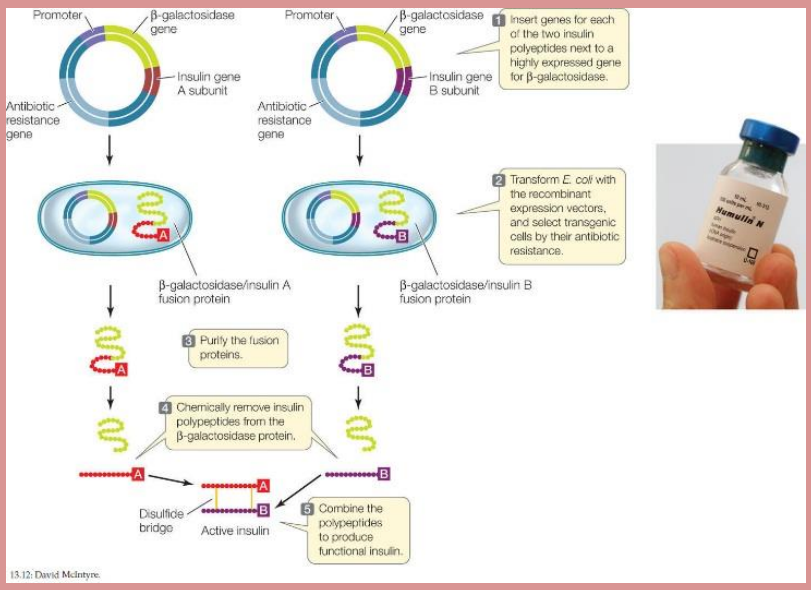


Figure- Genetically engineered insulin, (Source- Google)

## GENE THERAPY:

If a person is born with a hereditary disease, it can be cured by gene therapy.

Gene therapy is a collection of methods that allows correction of a gene defect that has been diagnosed in a child/embryo.

Genes are inserted into a person's cells and tissues to treat a disease.

Correction of a genetic defect involves delivery of a normal gene into the individual or embryo to take over the function of and compensate for the non-functional gene.

(Source-Google)

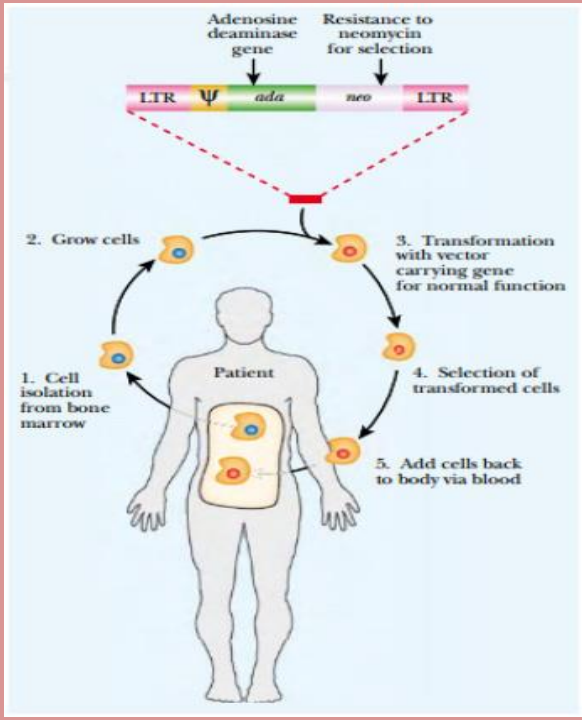


Figure- Gene therapy

(Source-Google)

## MOLECULAR DIAGONOSIS:

For effective treatment of a disease, early diagnosis and understanding its pathophysiology is very important. Using conventional methods of diagnosis (serum and urine analysis, etc.) early detection is not possible. Some of the techniques that serve the purpose of early diagnosis are:

Recombinant DNA technology,

Polymerase Chain Reaction (PCR) and

Enzyme Linked Immuno-sorbent Assay (ELISA).

Presence of a pathogen (bacteria, viruses, etc.) is normally suspected only when the pathogen has produced a disease symptom. However, the concentration of pathogens is already very high in the body.

With molecular diagnosis, very low concentration of a bacteria or virus can be detected by amplification of their nucleic acid by PCR.

## EDIBLE VACCINES

The Transgenic plants are capable of producing vaccines (Antigens) in large quantites at low cost, they are known as edible vaccines, thus the concept of edible vaccines came fromCharles Arntzen of Texas university, USA during 1990s.

The transgenic plant produce antigens that stimulate mucosal immunal system to produce secretary IgA (antibody at mucosal surface) such as gut and respiratory epithelial tissue, because these sites are involved in most pathogenic bacteria.

The production of edible vaccines by transgenic plants was first reported in 1990s in tobacco, now a number of antigens are produce in transgenic plants to use as edible vaccines.

(Source- Google)

## BIOTECHNOLOGY IN INDIA

The Department of Biotechnology manages most of the programs of biotechnology sector in India. It is under the Ministry of Science and Technology. Its objectives are:

To provide services in the areas of research, infrastructure, generation of human resource, popularization of biotechnology, promotion of industries, creation of centers of excellence.

Implementation of biosafety guidelines for genetically modified organisms, recombinant DNA products and biotechnology-based programs for societal benefits.

To establish an information network for the Bioinformatics mission of India in the scientific community, nationally and internationally.

### The programs undertaken in agriculture:-

- Wheat Genome Sequencing program.
- Rice Functional Genomics.
- Crop Biofortification and quality improvement program.
- National Plant Gene Repository program.
- Next Generation Challenge Program on Chickpea Genomics

## CONCLUSION

Application of biotechnology could be a major tool for development in all countries. Entangled with the culture and socio-ethical values, biotechnology could be utilized in solving future problems like food and water insecurity that delayed the national development.

## ACKNOWLEDGEMENT

I would like to express my special thanks of gratitude to my respected Professors of Botany Department of Hooghly Mohsin College to give me this golden opportunity to do this presentation.

I am grateful to my honourable Professors Dr. Biswajit De and Dr. Dipan Adhikari for their encouragement and providing the knowledge about the subject matter.

I would also like to extend gratitude to the H.O.D of Botany Department of Hooghly Mohsin College Dr. DebabrataMukhopadhyay for giving me all facilities that were required.

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- https://courses.lumenlearning.com/suny-wmopen-biology1/chapter/biotechnology-applications/
- https://www.toppr.com/guides/biology/biotehnology-and-its-applications/application-of-biotechnology-in-agriculture/
- **Plant Biotechnology, Volume 1 Principles, Techniques, and Applications** ***Edited By BishunDeo Prasad, SangitaSahni, PrasantKumar,MohammedWasim Siddiqui***

**Paper-VIII**

# RESTRICTION MAPPING

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## ABSTRACT

The objective of the experiment was to determine whether the given DNA plasmid was either classified as vector A or vector B.

Bam HI, EcoR1 and HINDIII were utilized to cleave the DNA in plasmid A by preparing single and double digestions with the perspective enzymes. The enzymes were capable of recognizing and cutting the double stranded DNA at different restriction sites. Through the process of restriction enzyme digestion and agarose gel electrophoresis, plasmid A was identified and mapped.

## INTRODUCTION

A restriction map is a diagram that indicates the relative position of restriction enzyme sites on a particular DNA sequence. To construct a map the DNA in question is cut with a variety of restriction enzymes both singly and in combination. The resultant fragments are separated by agarose gel electrophoresis and their sizes (in base pairs) are determined by comparing them with a standard size marker. The process of assembling a map is a somewhat trial and error process in which you construct possible maps, predict the sizes of fragments obtained from this map and compare the predictions with the actual data. The correct map is the one that accounts for all of the bands seen on the gel. Although the process is trial and error there are several steps that will simplify the process.

### What is DNA restriction map?

A restriction map is a description of Restriction Endonuclease cleavage sites (recognition sites) within a piece of DNA molecule.

A restriction mapping is a process which uses restriction enzyme as a tool to generate restriction maps.

**But what is this Restriction Endonuclease?**

It is an enzyme that recognizes a specific DNA sequence in a DNA molecule and helps to cut it in specific position (acts as a molecular scissor).

It is mainly of 3 types.

Type I and III: cuts other than recognition sequence.

Type II: cuts only within recognition site.

(Source- Youtube)

**Short introduction on restriction mapping:**

- Restriction mapping is a method / technique that determine the positions of restriction sites in DNA molecule by analyzing the sizes of DNA fragments to construct a map.
- Restriction maps are used as reference to engineer plasmids (relatively short pieces of DNA) and sometimes for longer genomic DNA.
- There are two approaches for construction of the restriction mapping through which we can analyse the length of the DNA.
-

**Approaches to construct restriction mapping:**

- To sequence the whole DNA molecule and to run the sequence through a computer program that will find out the R.S. present for every known restriction enzyme.

(Source- Youtube)

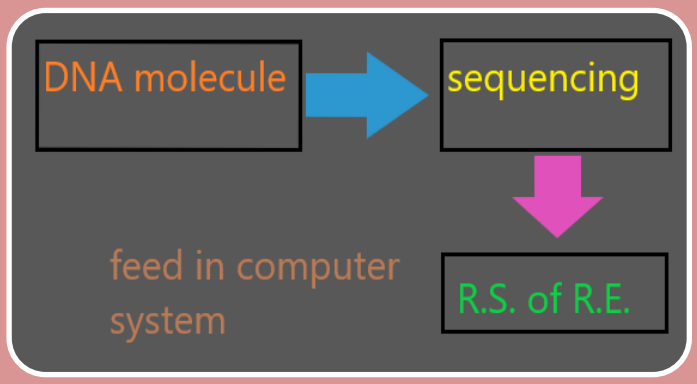



Figure- Sequence Processing

( Source – Youtube)

- To find the relative positions of restriction sites involving single and double restriction digestion. Based on the sizes of resultant DNA fragments, the position of sites is inferred.

(Source – Youtube)

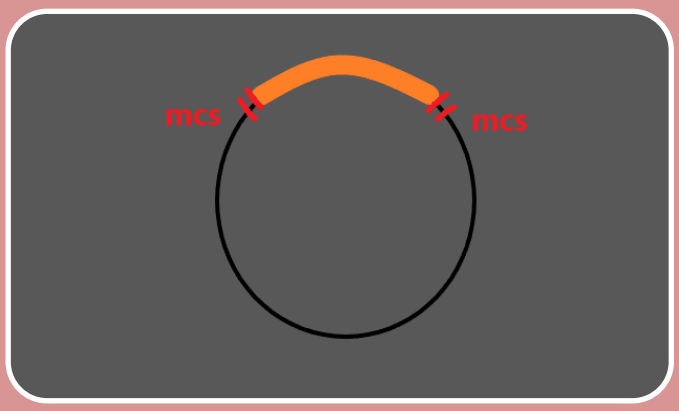



Figure – Single and double restriction digestion

(Source- Youtube)

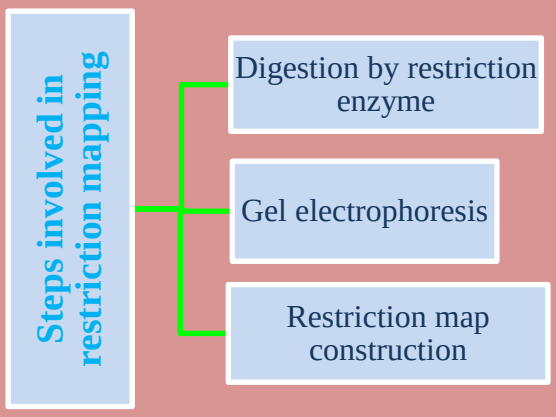



Figure- Steps involved in restriction mapping

(Source- Youtube)

**Digestion by restriction enzyme:**

- DNA sequence is treated with individual restriction enzyme in aliquot.

- Aliquot of DNA sequence is treated with combination of restriction enzymes.
- Double digestion can only be performed in one step if both enzymes have similar requirements e.g. pH, Mg++ conc. Etc.

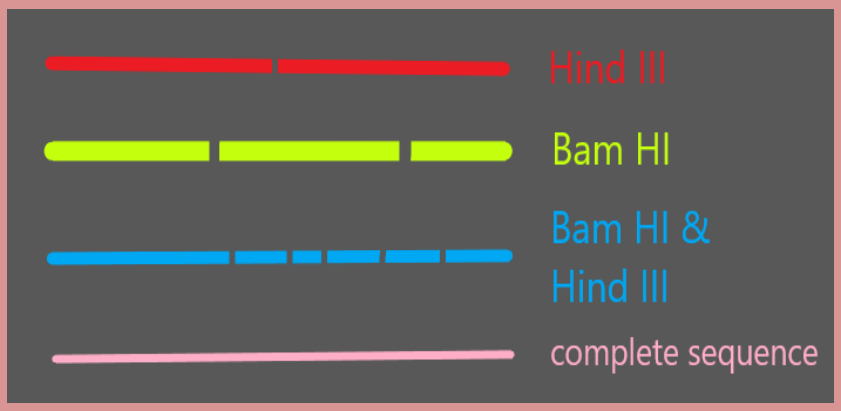



Figure- Digestion by restriction enzyme

( Source- Youtube)

**gel electrophoresis:**

The samples from digestion are then taken and run on electrophoresis gel (agarose gel).It is a process where the DNA isseparatedon the basis of size and mass.The size of restriction fragments and their numbers are measured by DNA ladders.We will visualize it through autoradiography and fluorescence.

(Source- Youtube)

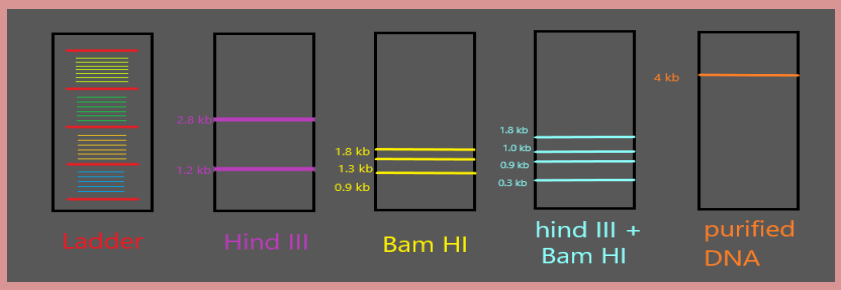



Figure- Gel electrophoresis, (Source- Youtube)

**Restriction map construction:**

- Adding up sizes of fragments in each lane. Their sum should be equal to size of purified DNA.
- Comparing the results of single and double digests will allow many of restriction sites to be mapped.

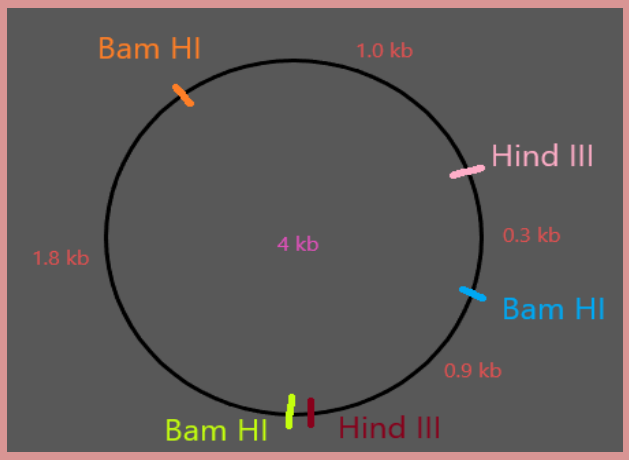



Figure- Restriction map construction ( for circular DNA fragment)
(Source-Youtube)

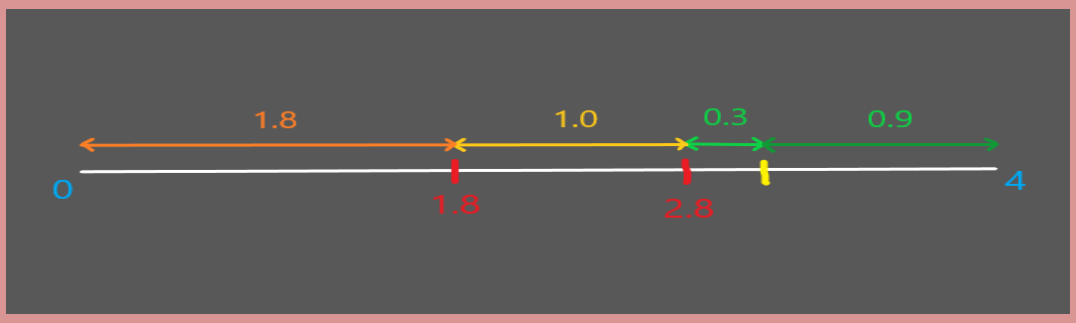



Figure- Restriction map construction ( for linear DNA fragment)
(Source- Youtube)

**Application of restriction mapping:**

- Identifying the size and orientation of the insert DNA.
- Checking the orientation of gene in cloning.

Digests: EcoR1 = 3 kb & 5 kb fragments

HIND III = 2 kb & 6 kb fragments

EcoR1 + HIND III = 2 kb, 1 kb, 5 kb fragments

GIVEN size of inserts = 3 kb and vector backbone = 5 kb

Here in this diagram Hind III site is in insert slighting off centre is 2kb away from end A and 1 kb away from end B. Hind III digest of clone yields 2kb and 6 kb . So orientation if insert should be from A to B. If insert would be cloned in B to A it would yield fragments of 7 kb and 1 kb.

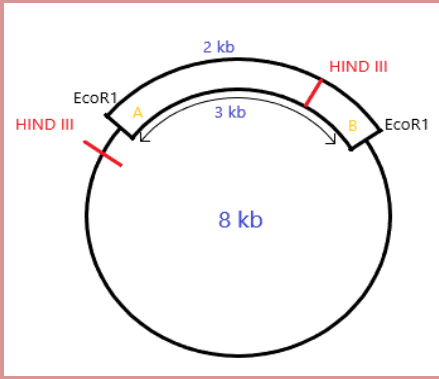
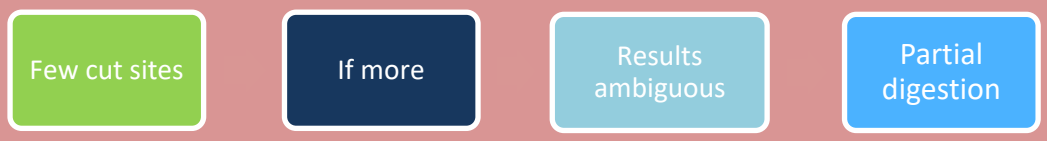



Figure- Checking the orientation of gene in cloning, ( Source – Youtube)

- Mutation studies and removing part of gene.
- To check whether the sequence we get back from sequencing lab corresponds to the piece of DNA we sent.

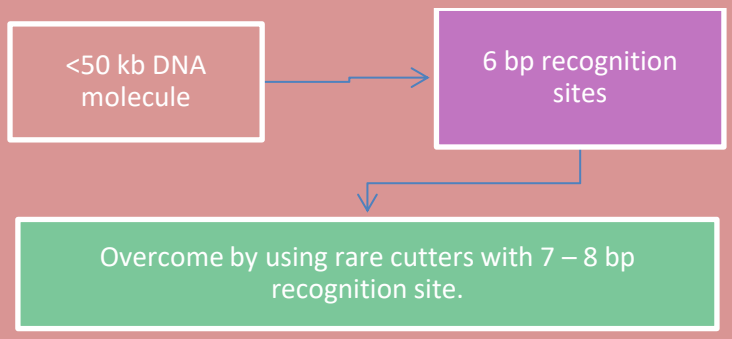
**Limitations of restriction mapping:**

- The restriction maps are easy to generate, if there are relatively few cut sites for enzyme being used. If so much restriction sites are present thenthe results become ambiguous.
- To overcome this problem partial digestions are used to resolve ambiguous positions of cleavage sites.




Another limitation of restriction mapping is:

- Restriction mapping is more applicable to smaller DNA molecules rather than larger DNA molecules.
- In practice, if less than 50 kb length DNA molecule is used it is usually possible to construct map for enzyme selection with 6 bp recognition sites.( Source- Youtube)




## EXAMPLES OF PROBLEMS ABOUT RESTRICTION MAPPING

**Problems related to restriction mapping: (for linear DNA)**
[ Source- Text Book of CELL and MOLECULAR BIOLOGY by Dr. Ajoy Paul]

Determine the restriction sites of the DNA fragment.

- EcoR1 = 3 kb, 3.5 kb (6.5 kb) length
- HIND III = 2 kb, 4.5 kb (6.5 kb) length
- EcoR1 + HIND III = 2 kb (A), 1 kb (B), 3.5 kb (C) (6.5 kb) length

Answer:

EcoR1: (A + B) = 3 kb; C = 3.5 kb;

HIND III: A = 2 kb; B + C = 4.5 kb;

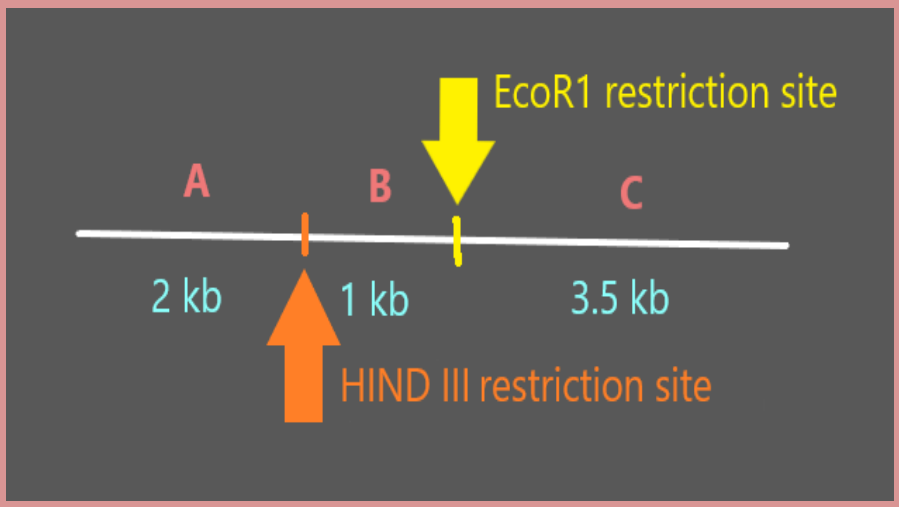



Figure- Restriction site of Ecor1 and Hind III in linear fragment

( Source- Text Book of CELL and MOLECULAR BIOLOGY by Dr. AjoyPaul)

**(For circular DNA)**
[ Source- Text Book of CELL and MOLECULAR BIOLOGY by Dr. Ajoy Paul]

- EcoR1 = 5.1 kb, 5.4 kb, 3.5 kb;
- HIND III = 6.5 kb, 1.8 kb, 5.7 kb;
- EcoR1 + HIND III = 1.9 kb (A), 4.6 kb (B), 0.8 kb (C), 1 kb (D), 3.2 kb (E), 2.5 kb (F).

Answer

- EcoR1 A + E = 5.1 kb; B + C = 5.4 kb; D + F = 3.5 kb.
- HIND III A + B = 6.5 kb; C + D = 1.8 kb; E + F = 5.7 kb.

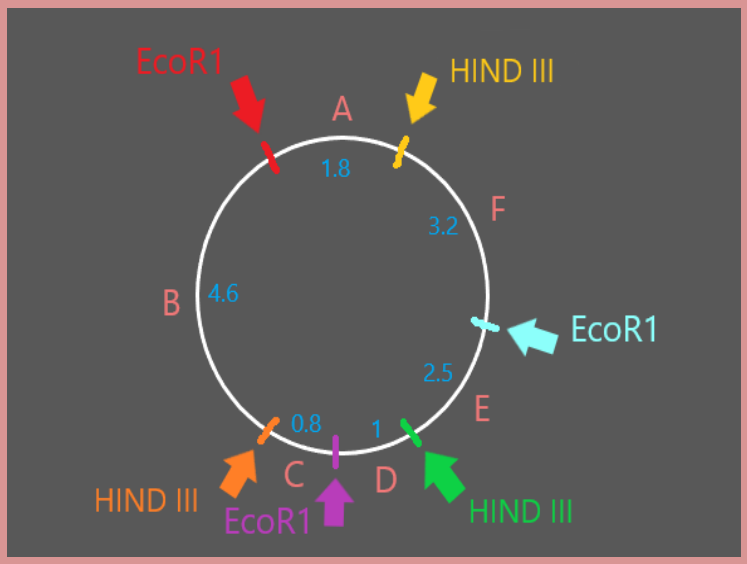



Figure- Restriction site of Ecor1 and Hind III in circular fragment

(Source-Text Book of CELL and MOLECULAR BIOLOGY by Dr. Ajoy Paul

## CONCLUSION

Restriction Mapping is a very basic technique by which not only the entire length of a circular (as well as linear) DNA, but also the position of the restriction sites can be determined. This technique is based on cleavage of the DNA using two or more Restriction Enzymes followed by their separation through gel electrophoresis. So, this process is comparatively very much simpler and easy to determine. Here sophisticated techniques like nucleotide sequencing, PCR etc. is not necessary. So it is very useful and easy method.

Limitation of the above techniques is that there can be multiple solutions for reconstruction. In this paper, we have studied a simple technique called partial digestion for restriction mapping.


## ACKNOWLEDGEMENT

I would like to express my special thanks to my professors, Dr. DebabrataMukhopaddhay (HOD), who gave me this golden opportunity to learn some useful information through the whole project work.

I would like to thank my friend, who helped me a lot in gathering different information, execute ideas, and make the proper execution of this unique project.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- https://youtu.be/75uWo6wg7x0

  Restriction Mapping (Physical Mapping techniques)

  Explained whole topic in easy Hindi Language…

  www.youtube.com

- Text Book of CELL and MOLECULAR BIOLOGY by Dr. Ajoy Paul (M.Sc, Ph.D, FICCE, FZSEI)

**Paper-IX**

# NATURAL OXYGEN FACTORY

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ABSTRACT **:**

Today we produce oxygen artificially, but it is not needed if we plant trees and do not cut down s trees. The natural $O_2$ level in air is sufficient for us to breath and for ill persons who have low oxygen level in their body. When plants produce glucose by photosynthesis, using carbon dioxide , sunlight ,absorbing minerals from soil through their root system and transfer in the inner membrane of plant photosynthetic pigment (PS1and PS2 ) and release $O_2$ molecule through water oxidizing clock to convert energy of sunlight into chemical energy as glucose form by using the catalytic enzyme carbon mono-oxide dehydrogenase & creating the O-O bonds use Fe & Ni. The whole photosynthetic process is called Z-scheme structure. A human breathes about 9.5 tones air /year . We only extract a little $O_2$ from each breath that's work out to a total of 740 kg of $O_2$ / year (roughly 7/8 trees worth). The net gain growth of oxygen is 5 %/trees/year. The relationship between trees and air pollution is complicated . Trees of other vegetation also restrict airflow in their immediate vicinity. If all trees are cut down the whole ecosystem will collapse. Indoor plants(spider plant, snake plant, Christmas cactus, peace lily etc.) also produces sufficient $O_2$ in house by releasing it through their tinny pores to survive naturally & increase longevity of our life. Scientist say that 100 indoor plants can change the $O_2$ level in home. A mature trees can absorb 48 pounds of $CO_2$/year. An acre of forest can absorb twice the $CO_2$ produced by average car's annual mileage. A single tree can produce nearly 260 pounds of $O_2$/year. One acre of forest produces this amount of $O_2$ in a year which is absorbed by 18 people in a single year. For this theory, we need to plant 40 billions trees each year. So we need to plant saplings and stop deforestation.

## INTRODUCTION:

Now-a- days our planet is in a dangerous phase for this pandemic disease Covid-19.We need oxygen for affected persons who haslow potential of oxygen supply in their body. But we don't give them as much as $O_2$ they required. The $O_2$ level in air became so poor, for this the ozone layer decreased and green house effects increased causing rise in global warming and water level too. So many skin diseases increase for this destruction of $O_3$ layer. If we start to plant saplings as much as possible , stop cutting mature and immature trees ,and deforestation for building new civilization, the $O_2$ level increases and we've sufficient amount of $O_2$ in open air from where we can collect $O_2$ and don't need to make oxygen artificially. The oxygen is produced by green plants through photosynthesis, otherwise some CAM plants like cactus, orchids, some grass etc. produce oxygen at night by crassulacean acid metabolism.

Here we talk about the process of oxygen production in nature and its sufficiency for Earth. 20% of oxygen in air comes from Amazon forest. So, it is known as "Lungs of Earth". Trees also help to prevent flood and drought, flues, soil erosion, etc. Trees can absorb sound and make a sound pollution free environment.

## OXYGEN PRODUTION BY PHOTOSYNTHETIC PLANTS:

Photosystem (1 and 2) is the protein pigment complex in the thylakoid membrane of chloroplast which produces oxygen by using $H_2O$ and $CO_2$,and energy of sunlight. Photosystem 2 reaction near the inner membrane takes 4 electrons from water and makes 1 molecular oxygen, this constitute the water oxidizing clock and absorbed sunlight is convert into chemical energy by photosynthetic organisms. As the heart of the process is the most fundamental reaction on Earth, the light driven splitting of water into its elemental constitutes and the molecular oxygen released, maintains an aerobic atmosphere creating ozone(O3) layer.

The $H_2$ that is released is used to convert $CO_2$ into organic molecules. Oxidation of these organic molecules leads to the recombination of the stored $H_2$ with $O_2$, releasing energy and reforming $H_2O$. This $H_2O$ splitting is achieved by the enzyme PS 2. Linkage through an electron transport chain to PS 1 directly led to the emergence of eukaryotic and multi cellular organisms. This organism depended on $H_2$ /electron donor( $H_2S$, NH3 & $Fe^{2+}$), that were limited supply compared with ocean water. The enzyme that catalyzes this reaction is CODH(carbon monoxide dehydrogenase). PS 2 and Fe and Ni containing from this enzyme (Fe-Ni CODH) suggest a possible mechanism for the photosynthetic O-O bond formation. In PS 2, the energy of 4 protons(H+) of light is used by the OEC (oxygen evolving complex) to drive the splitting of $2H_2O$ molecules to produce dioxygen.

(Source- Google)

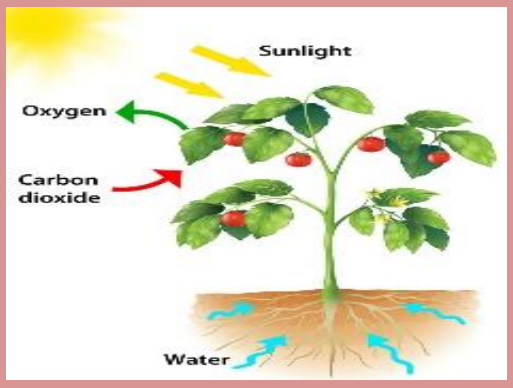
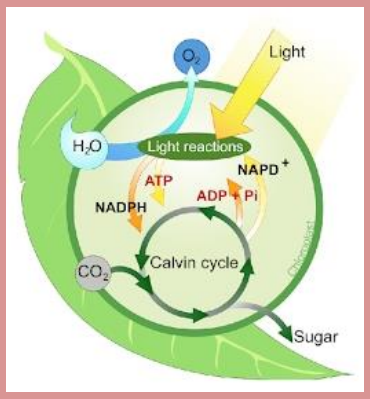



Figure- Photosynthesis

(Source-Google)

PROCESSING OF OXYGEN PRODUCTION BY PHOTOSYNTHESIS :



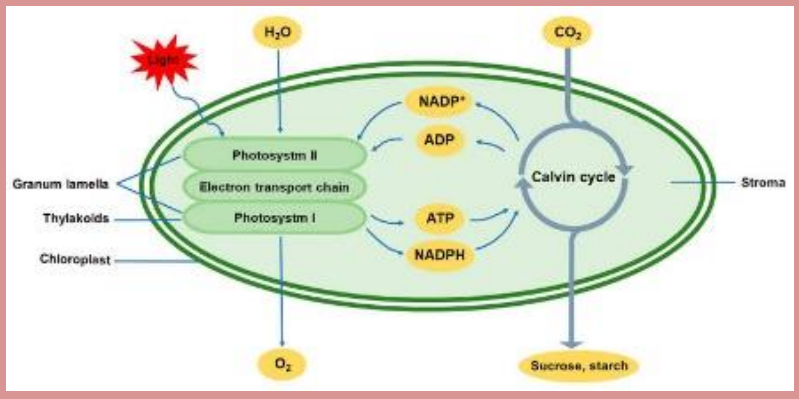
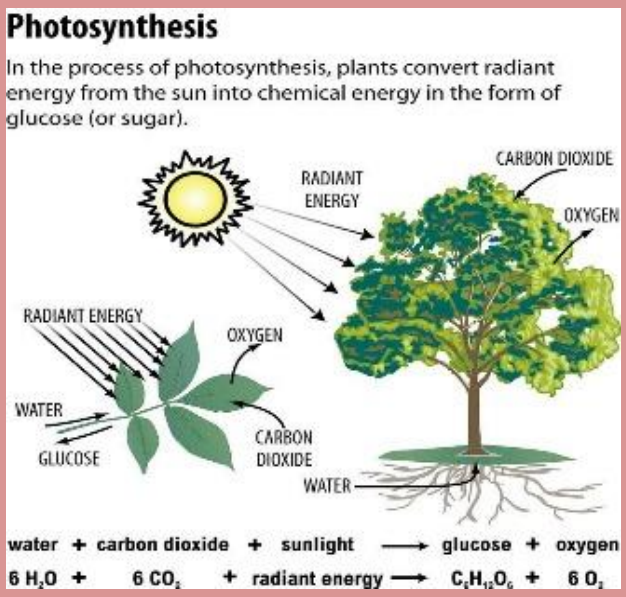




Figure- Calvin cycle Figure- Calvin cycle

(Source- Google) (Source-Google)

DEFINITION & REACTION OF PHOTOSYNTHESIS :



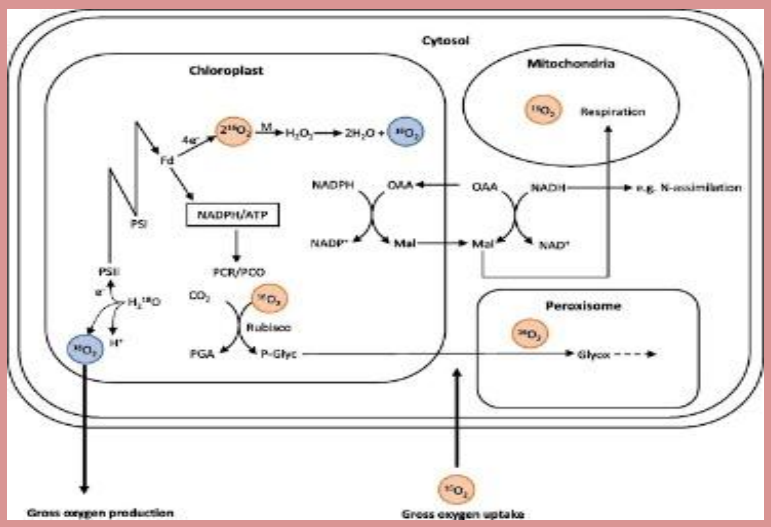




Figure-Reaction of photosynthesisFigure- Z-SCHEME Structure

(Source-Google)(Source- Google)

HOW MANY TREES DOES IT TAKE TO PRODUCE OXYGEN FOR A SINGLE PERSON ?

- Take a deep breath! You're in big surprise when you find out how many trees we need to provide oxygen for our lungs. Trees release oxygen when they use energy from sunlight to make glucose from $CO_2$ and $H_2O$. Like all animals, trees also use oxygen when they back down glucose to release energy for their metabolisms. In an average period of 24 hours , they produce more oxygen than they use up; otherwise there would be no net gain in growth.
- It takes 6 molecules of $CO_2$ to produce one molecule of glucose by photosynthesis and 6 molecules $O_2$ are released as a by-product. A glucose molecule contains 6 carbon atoms, so that's a net gain of one molecule of oxygen for every atom of carbon added to the tree. A mature sycamore tree might be around 12m tall & weight 2tones, including the roots & leaves if it grows by 5%/tree/year.
- A human breaths about 9.5tones of air in a year, but oxygen only makes up about 23% of year by mass, and we only extract a little over a third of the oxygen from each breath. That's work out to a total of about 740kg of oxygen per year which is roughly seven or eight trees worth.

(Source- Google**)**

Figure- Oxygen the savior of life (Source- Google)

DO TREES REDUCE AIR POLLUTION LEVEL ?

- Yes, trees can reduce the air pollution. The relationship between trees and air pollution is a complicated one. Particulate matter suspended in polluted air trends to settle onto leaves and certain gases including nitrous dioxide(NO2) are absorbed by leaves' stomata, filtering the air and reducing the pollution levels slightly.
- But trees and other vegetation also restrict airflow in their immediate vicinity, preventing pollution from being diluted by currents of cleaner air. In particular, tall trees with thick canopies planted alongside busy roads can act like a roof, trapping pockets of polluted air at ground level. To reliably improve air quality, city planners need to give careful consideration to how trees are placed.

( Source- Google )


Figure- Trees power, (Source- Google)

WHAT WOULD HAPPEN IF ALL THE TREES WERE CUT DOWN ?

1. **LOGESTICS:**A world without trees would be worse . There are 3trillion trees in the world. The timber industry currently cuts down 15billion trees per year, so at current rates it would take at least 200 years to fell all-probably much longer because a lot of virgin forest is hard to reach. If you give everyone aged 15 to 16 a chainsaw, each can cut down 625 trees , which might be manageable in a year. But collecting and processing that timber would take much longer time and 99% of the trees would just lie on the forest floor, rotting and releasing 35billion tones of $CO_2$
.
2. **ECOSYSTEM COLLAPSE:** Ecosystem collapse mean the destroy of the whole world. 80% of land animals and plants live in forests and without trees most of them will die. Trees also keep the ground wet and cool, and help to drive the water cycle. A large ecosystem can push 150 tones of water into the atmosphere each year, which then falls back on the forest as rain. With no trees, the land will heat up and dry out and the dead wood will inevitably result in enormous wildfires. This will fill the sky which soot that blocks out the sun, causing failed harvests for several years and leading the worldwide famine.

(Source- Google)

Figure- Deforestation

(Source- Google)

HOW MUCH OXYGEN DO INDOOR PLANTS GIVE OFF ?

During the daytime, most indoor plants absorb $CO_2$ from the ambient environment and use the gas to photosynthesis, to create food from light. In this process, oxygen is released. This gaseous exchange happens through tiny pores which are usually located underside of the plant leaf.. Giving off oxygen during daytime hours is thus something that plants quite naturally do to survive and increase the longevity of ours life. The average indoor plant will produce 900ml of oxygen/day or 27liters of oxygen a month, if we say the average growing plant has 15 leaves and each leaf gives an average of 5ml oxygen/hour for 12 hours a day. It will take around 3 minutes to consume that amount of oxygen by an average person.

(Source- Google)

DO INDOOR PLANTS MAKE A DIFFERENCE TO THE OXYGEN LEVELS IN THE HOME?

Humans consume around 50liters of oxygen per hour and each plant leaf gives off about 5ml of oxygen per hour. We would need 500 to 700 average sized plants to fully support the oxygen need of a human within an air tight room. Scientists say that 100 plants would however make a substantial difference to oxygen levels at home. It would seem that the oxygen generating effectiveness of your houseplants depends on the indoor plant aesthetic that you've created-whether you like living in an urban jungle or a more plan-minimalist space.

( Source- Google)

WHICH HOUSE PLANTS ARE BEST AT PRODUCING OXYGEN?

Some plants are more effective in generating oxygen than others. Here is a list of some of the more givers :

- Peace lily (*Spathiphyllum* sp.)
- Snake plant (*Dracaenatrifasciata*)
- Areca palm (*Dypsislutescens* )
- Spider plant (*Chlorophytumcomosum)*
- Gerbera daisy (*Gerberajamesonil*)
- Aloe vera (*Aloebarbadensismill* )
- Golden pothos (*Epipremnumaureum* ) etc.

(Source- Google)


Figure-Indoor plants

(Source- Google)

HELPING IN POLLUTION REDUCTION **:**

A mature tree can absorb $CO_2$ at a rate of 48 pounds per year. In one year, an acre of forest can absorb twice the $CO_2$ produce by the average car's annual mileage. This means we would theoretically have to plant 40billion trees every year. A tree can make nearly 260pounds of oxygen per year. The amount of oxygen produced by an acre of trees per year equals the amount consumed by 18 people annually. Trees also control the noise pollution. They can absorb sound and give us a sound pollution free environment.

( Source-Google )

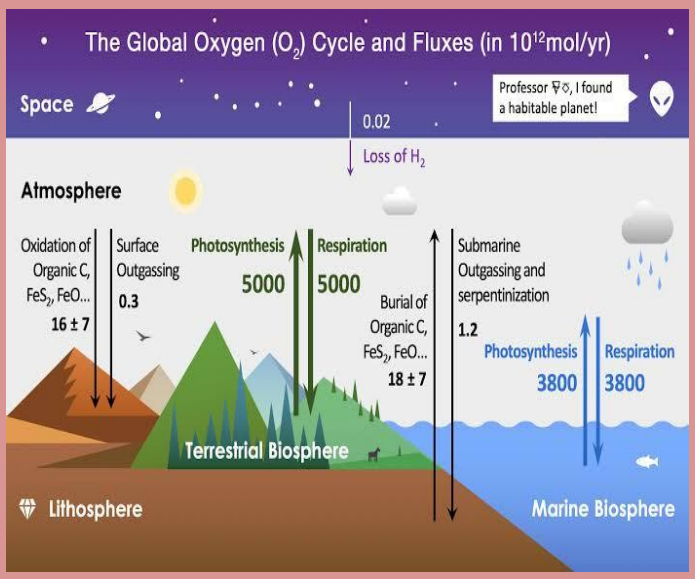
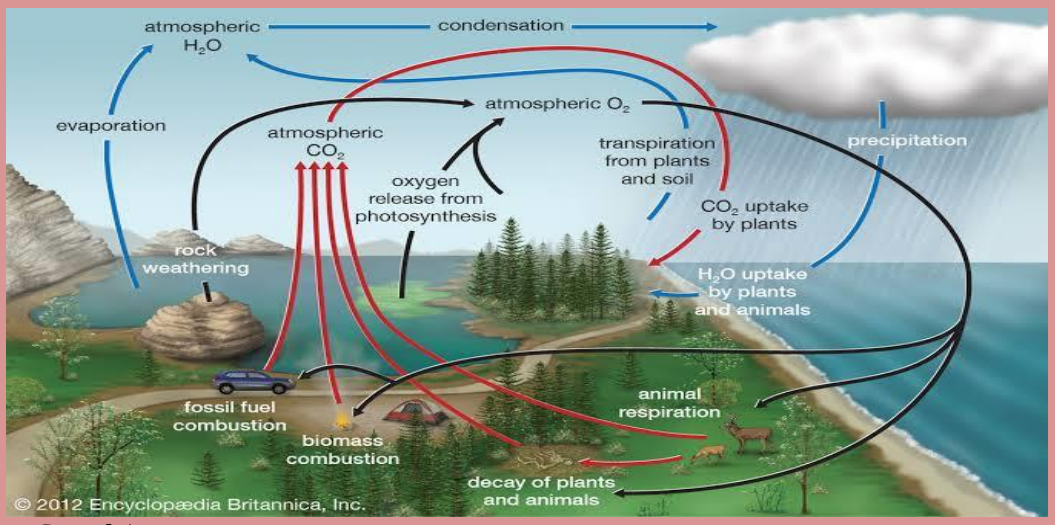



Figure- Global oxygen cycle

(Source-Google)

## COULD PLANTING MAKE ENOUGH DIFFERENCE TO IMPACT INCREASED $CO_2$ LEVELS ON GLOBAL?

Yes, planting of trees help to control global warming to control $CO_2$ level in the air. Since trees and plants take carbon dioxide for photosynthesis so, it seems that enough trees would reduce $CO_2$. The mass forest should be able to get to back to the biosphere and have impact on global atmosphere. The terrestrial biosphere removes about 45% $CO_2$ emitted by humans each year.




(Source- Google)

Figure- Carbon dioxide cycle

(Source-Google)

## COULD ENOUGH TREES BE PLANTED TO IMPACT $CO_2$ ?

While a typical hardwood tree can absorb as much as 48pounds of $CO_2$/year( 1 ton of $CO_2$by the time it reaches 40 years old). On average human activity puts 40billion tones of $CO_2$ into the air each year. We should plant 40billion plants every year as it cancels out the increased $CO_2$ levels.

(Source-Google)

## SHOULD WE REALLY CONTINUE TO PLANT TREES ?

Science magazine published a report titled, "The global tree restoration potential" which conclude that there may seem to be enough land to increase the world's forest areas by approximately 1/3$^{rd}$. Additionally the report states, "Even if global warming is limited to 1.5 degree Centre grade, the area available for forest restoration could be reduced by 5$^{th}$ by 2050 because it would be too warm for some tropical forest".

50millions tree saplings are planted tore-green the country, to replicate 8000 times to cancel the $CO_2$ created by humans. Global $CO_2$level could be reduced by planting trees, "If we act now, we can cutdown $CO_2$ emission, at least 25% levels wouldn't have been seen until almost a century ago."

So, we really need to plant trees and stop deforestation.

( Source- Google)

Figure- Afforestation (Source- Google)

WHY TREES ?

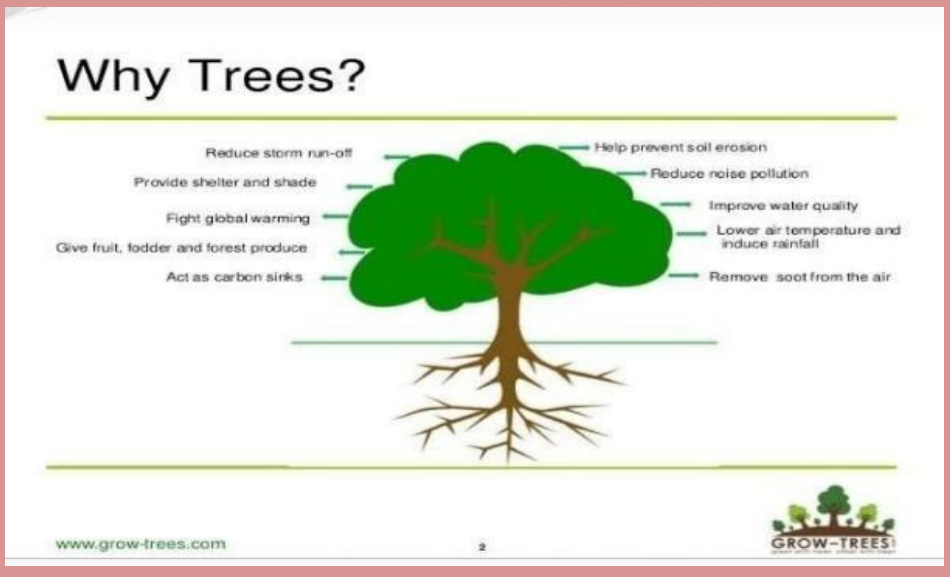



Figure- Trees are important

(Source- Google)

## CONCLUSION :

At least we can take the decisionthat trees help to maintain environmental conditions. So, we need to plant trees as much as possible. If we have so many trees, we would have a high level of oxygen and don't need to make oxygen artificially. This oxygen level is sufficient to collect $O_2$. Today we all are going through a pandemic session and there is insufficiet oxygen to give the required persons. If we don't cut trees haphazardly and make a proper plan for replanting trees, we can collect oxygen from open air in least cost, people won't die due to insufficient oxygen. If we collect oxygen from air the layer of ozone will become more destroyed and UV rays coming on Earth causes many diseases like Skin Cancer, Rashes, Sun stroke etc. If we love our planet, we must need to plant trees as much as possible. Otherwise the climate will become changed and the whole ecosystem ofthe Earthwill destroy. The planting of trees help to recover the ozone hole and control the climate changing as well as water level. For our better and safe future, we need to stop deforestation and require to plant trees.

## ACKNOLEDGEMENT :

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